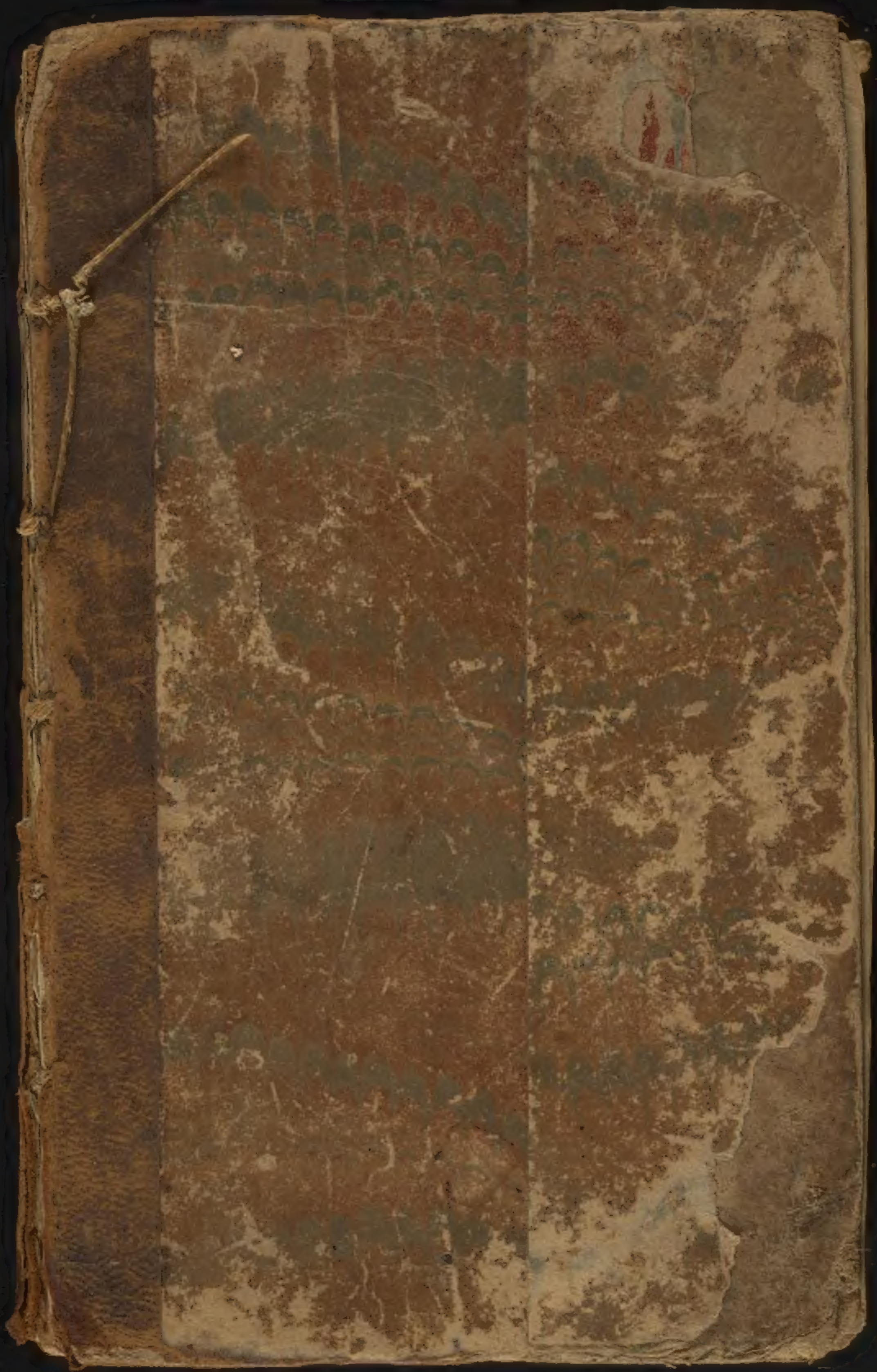

N.S. 1

Lectures

on the

Institutes of Physic

By

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Vol: I

1767-8.

"Physic, & Physic's Law lay hid in Night

"God said – let Cullen be, & all was Light.

Sarco-

Written by
Benjamin Rush.

4

1767.
Nov: 16th: Dr Cullen's Institutions of Physic.

The Institutions of Physic do not consist in mere theoretical speculations. They are designed to illustrate & set forth the Rules of practising Physic. in order to do this a Physician ought be well acquainted with: the State of the Body in Health, and all its Deviations from it in Diseases. he ought also know how the various powers of Nature affect the Body as to induce Disease which is the study of Remote Causes. the Business of the Institutions of Physic is to deliver the general Doctrines or principles of Medicine. we shall then 1st treat of the Doctrines of Health which is called Physiology 2nd of the Doctrine of Diseases which is called Pathology & 3 of the Operation of Medicines in curing these Diseases which is called Therapeutics, or the Methodus Medendi.

In the Physiology. I shall Often take Occasion to point out the Pathology

Introduction.

or Diseases to which the part we have treated off is subject. by this means we shall better understand the Nature & Functions of ye diffrent parts of the human Body in Health.

We shall divide our Physiology into 2 parts. 1st as it treats of the Functions peculiar to both sexes or the whole human species, & 2nd: as it treats of those Functions which are peculiar to each of the sexes.

Lect. 2nd

we shall begin by first explaining the Nervous System, as the Brain & Nerves are primary Agents in all ye Functions of the Body, even the Action of the Heart & Circulation of the Blood depend upon an Influence of the nervous power. After this we shall proceed to the Distribution of the Fluids or to the Circulation of ye Blood.

Introduction.

I shall call this the Hydraulic part of our System as the Blood in its Circulation is subject to ye common Laws of Hydraulicks. we shall then explain in w^h Manner ye Fluids are constantly renewed. This will constitute the 3^d part of the Physiology which we shall call the Chemical part of our System. This you may readily see includes those Functions w^h are called Vital & Natural. After this we shall subjoin an Account of the Functions y^t are peculiar to each of the Sexes.

Before I enter upon the discussion of ye Nervous System I shall say a few things concerning the Nature of a simple Fibre or simple Solids. I shall divide this particular Head (a) of their different Forms

of the simple solids.

(b) of the more general Functions of ye simple solids (c) I shall consider the different (c) states wch solids wd affect them.

d) of the Pathology of the simple Solids

(a) of the different Forms of the solids you all know from Anatomy y: it is a Cellular Texture. you will find it indeed Haller very fully discussed. we never find even two Fibres applied together wthout the Interposition of cellular Substance. Come Sir atomist, suppose the whole Body to be cellular more loosely or closely compacted together. the membranes are nothing but a close compact cellular Substance. the Bones themselves were originally Membranous therefore we may presume they are likewise cellular. does this apply to ye Nails - Horns - Hoofs &c of Animals?

1.R.) we infer this from the simple & distinct Sensations which are communicated by every single Nerve to the Brain;

of the simple Solids.

— this I think very doubtful. but it does not relate to our present purpose. even supposing parts of the body to be fibrous it does not affect their ~~ob~~ Texture in the least. when we come to examine them we shall find them both the same. see Dr Haller de Fibra et Vela Cellulosa in the Beginning of his Prima Linia. we allow the Existence of Fibres in the muscles and Tendons, but they are always distinct from the Cellular Substance. even the medul.y part of the Brain appears to be arranged in a fibrous manner, and when we consider the nerves are conti.d from the medulla we may presume the nerves also have a fibrous arrangement. especially whenever add to this, that the nerves & medulla are the embrio parts of the Body & these we are sure are fibrous. at the Application of this will appear more fully

of the simple Solids.

hereafter when we are showing how every part of the Body is derived from the nerves. I cannot help thinking y: the Fibrous Structure is the most Original, and y: the Cellular substance arises from it.

Lect: III.

I mention this because a late ingenious French writer One Mr Bordeaux, who has wrote on the cellular Texture of Animals in w: he tells us he has demonstrated Fibres in w: has been supposed to be cellular. he Observes that these Fibres are found in all Animals. hence the powers w: produce them are always uniform & the same. all Changes in the Solids then are in y: Cellular Texture, & not in the simple Fibres. this Hypothesis is ingenious, but cannot be supported. his Notions of Fibres are taken only from Muscles, & his Observations

pd Mr Meyes

of the simple solids.

were made w: the Microscopes w: we know are very fallacious. a later Author[a] has maintained the same Opinion, but I think w: the less surmise than Mr Dubourdieux. we must consider muscles not as simple Fibres but as organized Bodies as we shall show hereafter.

(b) The Functions of the solids. Solidity was necessary to give Firmness to the Body w: it always exposed to Injuries & Accidents, as also to serve as Agents in promoting the Circulation of the Fluids. it was necessary the solids shd have a certain degree of Cohesion – Flexibility & Elasticity which we observe in them. all the solids in our Body are supposed of one of these three properties or of all of them as was necessary for their

(2) or that they were Heterogeneous Aggregates. in the same manner as ~~Lime~~ Mortar which is Sand cemented together by Lime. —

of the Simple Solids.

Functions.

1c) the different states w: affect the Cohesion Flexibility & Elasticity of the Solids.

Their Cohesion depends upon their nature as Most Bodies y: is upon y Difference of matter w: constitute the Solids, united more or less compactly according to the matter of which they are composed.

Dr Boerhaave asserted y all the Solids are composed of Earth & Glutin. (a)

But this they infer from Calcinations & from a Glutin w: is extracted from Bones by Papin's Digester.

to the 1: by Calcination we Object all that can be said agt Chemical Analysis in general. Thus if a Bread Pudding be analysed, it will by no means yield those principles of which

(a) The Fire in Chemical Operations induces a new Aggregation in Bodies & does not teach us w: principles Exists in the Mass.

(b) wm this Salt is a Compound of Air & Salt. this kind of Doctrine arises from the Old Corpuscularian System.

(c) Air w: is the most essential Fluid Body in Nature when united w: certain Bodies form y most solid Concretes.

of the Simple Solids

it is compound, such as Flower-water Eggs &c. a new Arrangement is given to the matter, & new Compounds are formed. (a)

— the Earth in the Solids is the Basis of the Gluten, & can be extracted from it. it is unphilosophical to seek for the Cause of Solidity, as it does not arise from any One Elementary Body but from a Conjunction of a considerable Number of them. Thus Vegetables are resolved into ye Same Earth, (b) but can it be the Cause of their Solidity? — no. The Solidity then of all Bodies depends upon a certain Arrangement w^h is altered by Fire (c). the same principles when differently arranged would perhaps form a soft Body.

of the simple solids.

as to the 2nd Argument, it proves nothing — the Gluten arises from a Decomposition & did not preexist in the Body.

~~[illegible]~~ Having rejected the Hypothesis of Dr. Boerhaave I now add y: altho' we find Heterogeneous Masses in Nature, yet we have proofs y the Animal Solids are composed of Homogeneous Aggregates. — They were originally in a fluid Form, and by the Dissipation of Moisture become solid. — Thus a Spiders web by being drawn out becomes solid altho it lay in y Spiderine fluid form. Besides the Animal Solids are perfectly transparent wch show their Simplicity. — I write not deny but they are Compounds for Nature has

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Of the simple Solids.

presented us w: Nothing in a simple form:
— The Chemists indeed tell us of Air-
fixt-sulphur &c entering into y Composition
of all Bodies, but this Notion is now exploded.

This Compound may differ in the
proportion of its parts, or from
the Insinuations of foreign Matter,
on this the different states of Cohesion
Flexibility & Elasticity in y Animal
Solids may depend. But when these
Variations of proportion take place
or when foreign matter is insinuated
is difficult to tell. we can hint at one
or two Cases only, in the Lungs wherein
Degree of Putrefaction takes place a late
ingenious Author has shown us that
it is occasioned by a Defect or Abstraction
of Air which is one of the ~~principals~~ con-

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of the simple solids.

= stituent parts of the Animal solids.

2nd: in many Diseases as in Cancer when some foreign Matter is introduced which changes the state of Cohesion.

3d: Water when introduced may alter the Aggregation of our Solids, so that a greater or lesser proportion of this fluid may change the state of Cohesion in the Animal Solids.

— ~~food~~ all Nutritious Matter is applied in a watery form, now if this is sent in too great a proportion or if it has not been properly Abstracted, or if after being Abstracted it is again effused, it follows of Consequence we shall have a Change in the Nature of the Solids..

If Again this Fluid is sent in too small a proportion. or if too much is Ab= stracted or distributed then a Difference of

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of the simple solids.

Aggregation will likewise follow. the direct Converse of the former viz: y: Solids will become more coherent - less flexible, & more ~~liable~~ liable to Diseases. — I shall here Only of the Soft Solids. I shall have occasion to say hereafter that the Bones are composed of Heterogeneous parts.

Dr Bryan Robinson by his Experiments on Animal Fibres found y: all Liquids tend to elongate them. But he never found any thing that contracted a Fibre thus re=laxed or elongated. See his Tables in his Treatise on the Anim: Oeconomy.

From w: he has said I w: infer that no Liquid relaxes ~~less~~ more than hot water except Fl: vitriol w: acts rather as a Solvent than Relaxer.

a Solution of common salt relaxes

(a) hence he tells us y^e Oils relaxed very little. nor do we allow y^e Oils relaxe= = lax more of any fluids when applied to the skin.

(b) For he never distinguished between different kinds of spirits he used: nor does he seem to understand y^e nature or difference between the two various kinds of Alkaline salts.

of the Animal Solids.

the least of any Liquids the Reason of w: is owing to the fall: prevent the free Passage of the water into the Animal solids, and this is the Cause w: the all the Impregnations of water. I would not have you however trust too much to these Experiments for y: he used Human Hairs as his Animal solids; now they are so close & compact in their Organization as not to admit the Insinuation of fluid Bodies so readily as other parts of Animal Matter. (a) 2d: he is very inaccurate in his Chemistry & loose in his Chemical Reasonings. (b) He tells us y: Vinegar relaxes less than water, but very Anatomist will tell you y: Vinegar softens the Bones more than any Fluid in Nature.

– I wish some of you Gentlemen w: repeat these Experiments the w: more accuracy.

of the Animal Solids.

Dr Hales in his Hæmistatics gives us several Experiments y^t lead to some general good Conclusions on this Subject, Altho his manner of conducting them don't seem to be Altogether proper.

We return now to consider the Animal Solids wch we cut found composed of Water & other Matters. its Strength or Solidity depends upon the proportion of the Matter to the Water. We shall enquire in to the remote Causes wch give these different proportions of fluid & solid matter. They will depend 1st upon the Quantity & Quality of Nourishment taken in, and ye Condition of its Application. 2dly too much Nourishment introduced tends to increase the proportion of Water especially if no Exercise is used to dissipate ye superfluous

as the more nutritious Aliment is the
larger & stronger Fibre it gives, & vice
versa. Water when combined wth Nutri-
-ment tends to make it go further, as
those who near Salves suddenly can
witness, from whence we see ye necessity
of nourishment being applied in a fluid
form.

of the Animal Solids

moisture. if Exercise is used it will tend to enlarge the Solids & in grown subjects to harden them. Too little nourishment gives a small & rigid Fibre. 4th Regard to the Quality they act according to the proportion of nutritious matter they contain. (a) [Cohesion & Flexibility is different in different Constitutions - Ages, Sexes, - & Temperaments.

The Elasticity of the Solids depends not only upon the proportions of the constituent parts, but upon their Arrangement likewise.]

The Growth of the Body will depend upon the state of the Evacuations. Too great Exhalation & Perspiration prevents nourishment (tho taken in over Quantity) from being applied to the Nutrition of the Body. 2nd it will depend upon the State of the Assimilating powers.

of the Animal Solids

Therefore neither Quality nor Quantity can give Nourishment Unless they are suited to those Powers. 3rd: it will depend upon the Powers which apply it such as Exercise — the Temperature of ye Air & Other Circumstances not understood such as perhaps Pressure. 4th Exercise tends to harden the Solids, hence hard Labour in early Life tend, to limit the Growth of the Body. Heat by encreasing the Motion of the Nutritious Fluid, and thus encreasing the Quantity applied — hence people arrive sooner at their Prime in warm Climates ye: in cold. Dry ness encreases the Effects of Heat & Cold — Moisture diminishes ye: both, these influence ye Growth of ye Body considerably. 5th: it will depend upon

of the Animal Solids

the Original stamina of different Constitutions which cannot be investigated by us. —

We shall now point out some Causes of Tension in the Body.

1st The Tension of Fibres will depend upon the Bones they are attached to. they will therefore be greatly influenced by the growth of the Bones.

2nd The Fibres of the Body are stretched by weights constantly applied to them. — such as the Bone prevailing over another — Our Dress. Occupations in Life &c.

3rd Some parts of the Fibres of the Body are at times overstretched by the Matter they contain — such as the Intestines & Stomach — which are over distended

Of the simple solids.

w: Aliment or wind. when the tension of these is destroyed we find the whole Body brot into sympathy. we find the Lungs greatly influence every Fibrous part of the body. hence when we want to exert the whole Body we fill the Lungs by a large Inspiration.

— the Thorax & Abdomen are held in a state of tension by the vapour rarified out into them w: is in an Elastic state. this too I believe tends to keep the Cellular Membrane in its proper state of tension. we have some Reason to think the Cellular Mem:brane is a permanent aerial Membrane constantly filled w: the air. consult Mr: Jenae on this subject. if so

Of the simple solids

This is the case may not this air tend to keep the fibres in a state of tension? But further if the fibres are hollow, may they not be filled w: a ductile fluid w: contributes likewise to keep the fibres tense. These causes hitherto pointed out are in: = ternal, But there are several exter: = nal causes w: influence the state of tension in the body as the different state of the incumbent air. The tension is further kept up 1: by all the parts of the body being united together more than one fibre, or membrane. Now if any of these are destroyed, the tension will of consequence be diminished, as we see in aneurisms from the internal coat of

of the simple solids.

an Artery being worn away. 2nd: the state of Tension will be varied by the Exercise or Action w: the Fibres undergo. 3rd the Fibres will be firm & Elastic in proportion as they are filled w: vapour. but if they are filled w: Gelatinous Matter instead of Vapour a Flaccidity will be induced.

4th: a Morbid Rigidity will be induced when the Matter w: forms the Bones is effused into the cellular Membrane.

5th: a Rigidity will be induced when coagulable Lymph stagnates in the cellular Membrane.

6th: a Morbid Flaccidity will be brot on when a solid Matter is washed from a part to w: it belongs as in Cases where the Bones grow soft. this may

occasioned by too much water being insinuated into them? But why don't we find them swelled if this is y case? we generally find them diminished. The water then must act as a solvent & thus wash out the solid parts of the Bones. But how this water acts as a solvent I cannot say. we are sure it is not acid, nor can I think it has any kind of chemistry.

7: The state of Tension in y Cellular Membrane will be varied according as it is kept longer or shorter in a ~~contracted~~ contracted or distended state.

(d) we come now to treat of the Pathology of the simple solids. But of this we have limited pretty largely

of the Simple solids.

When treating of their Physiology. I shall 1st point out their morbid affections & 2nd endeavour to point out their causes.

1st These morbid affections are to be considered in two views (a) the naturally soft parts (b) the naturally hard parts. (a) the soft parts are liable to diseases from the excess or defect of Cohesion Elasticity & Flexibility: we must observe 1st these are even in a healthy state different in different ages. 2d is Rigidity in a young person is Health in an old person. the first diseases they are subject to, are Debility Flaccidity & Laxity. By Debility I understand a weakness in the state of Cohesion.

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By Laxity I understand a Defect of Firmness. Cohesion & Elasticity being given, & arises from an Excess of fluid Matter in the Solids wch destroys their Firmness without lessening their Cohesion. By Flaccidity I understand a Defect of Elasticity. I believe it is seldom seperated from Laxity, but we shall consider them as different.

Diseases from Excess of Cohesion Elasticity & Flexibility are 1° too much Rigidity when Flexibility is destroyed wch induces too much Elasticity. as they are never seperated I include them both together.

1st the Diseases of the hard Parts are of 3 kinds 1° the hard Consistence remaining wch the weakness of Cohesion,

1st Lord Anson's voyage round the world.

2.do where the hard Consistence remains
th w: Excess of Cohesion: 3.rd where the
Consistence in the hard parts is lost or
destroyed.

2nd 2: we now come to enquire into y c
remote Causes of these Diseases.

1 Debility. this depends (a) upon
a weakness of the original stamina.
(b) upon the want of Nourishment or a
want of proper Assimilation - or Appli=
=cation of Nourishment (c) it depends
on Aliment 1st contains too little nutri=
=tious Matter, or 2d abounds too much in
water (d) upon vitiated Nou=
=rishment. thus the Fourth th: claims to
depend on Debility is brot on by bite=
=ted Aliment. this we know from
old wounds (a) breaking out afresh

(a) May not the Rickets - Scrophula &c depend upon this Cause?

w: shows us how much the Cohesion of the Solids is destroyed (e) it depends upon Corrosive powers applied from without w: distinguishes this Mud from the last. thus the Matter discharged from Cancers induces a Tranquility in every part it touches. (f) it depends on too much Extension called by Dr Gaubius "Distensio Ruptura proxima" (g) upon a loss of some of the Fibres w: connect the Solids.

thus an Artery when wounded its Coats is broke. is said to be in a state of Debility (h) upon a diminution of the weight of the blood. all these Causes of Debility are attended w: Lassitude.

(i) Debility w: Tranquibility depends upon moisture being dissipated from parts

to wit it belongs as from the skin.

2nd Laxity. this is distinguished from Debility as it is brot on rather by Excess than Defect of Motion. the remote Causes of Laxity depend (a) upon y Original stamina of the Constitution which determines the Fibres to be more lax in some Persons than others (b) upon abundant watery nourishment, (c) upon a want of the drying powers applied to the Fibres. Solids become such by an Abstraction of Humidity. when this is not abstracted a Laxity will be induced. Exercise is the chief of those applied powers (d) upon the application of relaxing powers wt are 2, Heat b Moisture. Heat relaxes by resolving the consistent parts of the solids. Moisture

relaxes most powerfully especially when joined with Heat. Dr Benj: Robinson found the relaxing power of cold water to be 35°. I think y relaxing power of warm water may be fixed at 80.

— But does moisture penetrate beyond the Cuticle? — I much doubt whether warm water insinuates itself beyond it. it is absorbed & circulates thro' the Lymphatics & may thus act on the whole Body like Excess of Humidity introduced by the Mouth. hence we see the Absurdity of those Medical Authors who talk so much of the relaxing power of Moisture. it never can enter y solids immediately, and it relaxes only in a secondary way, by being poured into them from y. Mass of circulating Fluids.

of the simple solids

3.d Placidity. The Remote Causes of this Disease are (a) those Causes of Rapidity viz: introduce moisture into the cellular tissues. (b) too long Rest in an extended state (c) too much Pabulum Oil or Water introduced into the cellular membrane more especially the last.

4.th Rigidity. depends (a) upon the state of the Original stamina. (b) Upon Redundant nourishment Quantity Density & Application (c) upon constriction & condensing powers applied. The most powerful of these is Cold especially when it is excessive. hence we see how it limits the Growth of Mundy & other Animals in very cold Climates.

but Rigidity is not always proportioned to Cold, for the retained Perspiration by its Moisture counteracts the constringing powers of Cold. excessive Heat likewise by dissipating Moisture induces Rigidity. (b) Astringent Medicines are said to bring on Rigidity. but Dr. Robinson found the Solutions of Alum & Vitriol rather relaxed than contracted the Fibres he used. in ye human Body they constringe only by acting on the Solida Viva or Nervous system. (d) upon too much Rest in a contracted state.

(e) upon every degree of Tension within ye point of Bursting.

(f) Rigidity in the Organized parts of the Body depends upon Compression especially in the Cellular Membrane. It is owing

Tadhesion

of the simple solids

to this q: Our solids are acquiring strength in the progress of Life

(g) Rest in a contracted posture. Speak of hence of Rigidity induced by cell: substance.

(i) Rigidity will be brot on where the solid parts are deprived of intervening Fluids. hence the Accretion of Lymph to the Pleura, & of the Gutts to Cre Ano: ther. the Exudation of Coagulable Lymph forms the connecting Medium.

(k) Rigidity is in the last place brot on by such an Extension as gives Occasion to a new Growth.

To all than we may add a Rigidity in: duced when all kind of softness is destroy: ed as in the Case of Ossification.

I shall now proceed to the Ho: tice of the naturally hard parts.

of the simple Solids

These are subject to three kinds of Diseases.

1: When Cohesion is destroyed, & a tender fragility induced. does this depend on the Bones being heterogeneous Masses & upon one of their constituent parts being washed away? I think not.

— If rather seems to depend upon corroding powers applied to them which erodes them. W: is the nature of this corroding Matter? we cannot tell. we can only say that there appears to be different species of it W: we may infer from the chemical & the surbutic, & the scrofulous Caries differing from each other.

2nd: When Flexibility is ~~[illegible]~~ destroyed & Bones becoming as y: they break easily. it is hard to tell. When this occurs. it is cap

(2.) Residents Lucks as Falls Likewise happen Oftner in winter than in summer from the Ground on which we walk being more elastick.

of the simple solids.

Disease incident to old People w.ch is owing to the Quantity of bony Matter increasing by Age, from a Diminution of the water w.ch are necessary to give the Bones a due Flexibility.

Dr Quelius takes Notice of a Fragility in the Bones w.ch takes place in Winter, w.ch he infers from Fractures happening Most in that Season. But this can not be true. no Cold can reach the Bones without debaging life. the generating Powers of Heat in a System overcome the Action of the most intense external Cold. the Fractures w.ch occur in Winter may be rather imputed to the Muscles acting w.ch more Force upon the Bones than in Summer.

Of the simple Solids

3 The Stones are liable to a Disease where they lose entirely their solid Consistence. in all these Cases & size of the Stone is diminished. It may be cured either on Acrimony applied to them w: I think rather improbable. — or upon mild dissolving powers w: do soften them as to make them more easily absorbed into the System. This I think the most probable Opinion.

of the Nervous System.

a knowledge of the Functions of the Nerves is of the utmost importance not only in the Physiology but in the Patho:logy as you will see more fully here:after. All our Motions both Vital & Animal depend upon them. therefore I hope you will excuse me if I dwell a little upon them, & endeavour to illustrate some of their Functions.

The Nervous System along the Brain Cerebellum the Medulla Oblongata & Spinalis it comprehends likewise the Nerves w: are distributed to every Sensible part of the Body. The Extremities of the Nerves are all

Of the Nerves

connected wth two sets of Organs by which
of Sense and Motion. Under the Head of
Sense I do not mean to treat of all
the Senses, and the Manner in wch sensations
are communicated to the Brain by them,
nor under the Head of Motion do I pro-
-pose to treat of the Crime of Muscles &c.
- these are equally foreign from our Sub-
-ject. - The Whole Phænomena of the
Nervous system may be reduced to
1 Impression, 2nd Thought, & 3^d Contraction.
- do all these Phænomena deserve Motion? I am far from asserting it.
- 2nd is not the property of Nerves but
depends upon Spirit or some or some immate-
-material principle. But I affirm that it

of the Nerves

it never can exist without motion; it is without impressions communicated by the Organs of Sense or Motion, according to the Maxim of the Schools "Nil est in Intellectu quod non prius fuit in Sensu".

of Impression

The Sense as here used is confined only to the Actions of those Bodies wch are made on the Nervous System. it comprehends all we can discover in external Bodies y^t are relative to Ours 2nd it comprehends the Motion excited in the Extremities of the Nerves. 3rd it comprehends ye Motion wch is propagated from ye Extremities of the Nerves to their Origin. There make no Distinction between the Organs of Sense & Motion, as Impressions operate equally upon them both.

(a) the word Mental Impressions are improper, as the Operations of the Mind we here speak of are two ways connected w: Impressions.

of the Nerves

Impressions are divided into two kinds
i.e. Corporeal & 2nd Mental. W.th the 1st are
those w.ch are made by the action of Bodys
the 2nd are those which Thought is
produced without any manifest motion.
Ideas or Sensations are either direct or
reflex. The direct are such as sound & light
receive on the Mind. The Reflex are
such impressions as are attended w.th Plea-
sure or pain, & are more properly Mental.
I shall here speak only of those
Impressions w.ch are Corporeal as these
can be more distinctly marked. I shall
not confine this kind of Impression to the
external surface of the Body, but to
all those things w.ch operate within y.e
Body especially such as are extraneous
such as Worms, Calculi &c. I shall

(a) these are not to be used Imperfections
as ~~they~~ they arise only from the ill state
of the Organs

extend these Corporeal Impressions to such as are excited by the Blood, for we shall find ye Dreams & Delirium depend upon its different States in the Brain. Now the Corporeal Impressions naturally divide themselves into 1st Internal and 2d External. There are certain sensations excited in the Mind from Want of Impressions such as the disagreeable Sensations wch arise from Pleasure or Darkness. Impressions will depend upon ye different States of our Nerves. Thus that Coldness produces Sensations according to ye Degrees of Heat & Cold in our Bodies. There are Sensations excited in the Mind wch do even arise from the Action of Bodies externally on the Nerves. This is a Distinction of Importance, & wch be often attended to.

of the Nerves

I shall now speak of ye different Senses of external Impressions. They are of 5 kinds according to the Distinction of most Philosophers. Smell - taste - Sight & Hearing are all alike in the Sensations excited in them. all the other Sensations are referred to Touch but this is improper, for this Sense is too extensive & too much divided to be reduced to one name, both externally & internally. The Glottis affected wth every thing y^t comes in contact wth the Pituitary Membr. wth Air. the Stomach is affected wth a Stimulus y^t produces no Action on ye Eye, & vice versa. does not this furnish some Suspicions of specific Stimuli?

All Sensations are communicated by a Subtile Ether wch fill Space

(as this supposes) two, y: the Nerves must be always stretched in order to suffer this inelastic Fluid to pass, therefore now this we know is not the Case.

— That Sensations cannot be communicated by the Nerves as tense Elastic Cords is a Supposition too absurd to be insisted on.

Newton first hinted at. This Fluid is not an aqueous inelastic substance as Dr Boerhaave has supposed, for it such a Fluid never could be fit for the velocity & accuracy with which Sensation. (a)

Vision depends upon Oscillatory Motions excited by the Rays of Light

Hearing depends likewise upon certain Oscillations excited on the Auditory Nerve by tremulous Motions in the Air which arise first from a tremulous Oscillatory Motion excited in the Sounding Body

Smell may be accounted for in the same Manner from Particles whose floating in the Air which produce

(as The variety in Smells depends on the Mixture formed by from the floating Body & the Vapor in Air.)

Vibratory motions in the Nerve. &
thus Taste & Touch might be illustrated
in the same manner.

I do not pretend to say w^t ye Nature
of this Nervous Fluid is. Dr Haller denies
its being of an Electrical Nature. I do
not object. If it is, Nor is a supposition
necessary to ex^t for the Phenomena
of Impressions. it may be a Fluid
somewhat analogous to it.

But from whence is this Fluid derived
& how is it confined in the Nerves? this
is a difficult but not a desperate
~~subject~~ question. Sir Isaac Newton has
supposed y^t all Bodies however solid
are inveloped wth a Subtile Ether w^ch
likewise pervades them, & on this

of the Nerves

he supposes Attraction & Repulsion
depends. 2.nd all the Phenomena of
Electricity depend upon a subtile fluid.
- all fluid Bodies of every nature are non
Electricks. all Solid Bodies (Metals excepted)
are Electricks. 3.rd the same subtile
Ethereal fluid gives the whole Phena=
=mena of Magnetism in Gen.l. Now may
not the Medullary Fibres from their
Original Conformation have a subtile
Ethereal Fluid adhering to them like
the Magnet? we are acquainted only
w.th the Vibrations of Air, but as the
Other heading to Sir Is. Newton's Opinion
is Millions of times finer so he supposes
y.t its Vibrations may be carried on
w.th Millions of times quater velocity.

of the Nerves.

Plants have been found to be possessed of Irritability. This can only be by means of some subtle Material Fluid.

— From all this we may assume such a Fluid is in the Nerves. we dont pretend to say it is analogous to any of the Fluids we have mentioned: it is different from them in some things, as Dr Cullens supposes.

But from whence comes this Fluid in our Nerves? — here let us have recourse to Electricity. we find some Bodies have a power of accumulating it, others again propagate it as soon as it is thrown in them. thus we suppose the Nerves ~~also~~ to attract it from all ~~the~~ surrounding Bodies.

Dr Baker imagines y: this Fluid is derived from our Food. But we shall know y: hereafter y: it is not liable to Secretion or Reflection. For the Nervous Fluid is neither present in our Aliment nor nourishment nor is it ever converted w: them till they are converted into Medullary Matter. If it is in our Aliment its Particles must be in ~~not~~ changed before it is admitted into the Medull: Fibres. Thus we find melted Sulphur has no Attraction to the Electric Fluid, but when hardened into a Solid Mass becomes a powerful Electric. For Proof of Opinion w: Dr Bourdeaux y: the Medullary Fibres are of an immutable unchangeable Nature. But how is it that

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this Material Fluid is confined? — to this I answer y: all bodies have a subtile Matter adhering to y surface, w: has no Disposition to unite w: the surrounding Air. this ~~Matter~~ solid is Elastic & disposed to expand Quantum Quale, & yet we find it may be propagated along a Metallic Cord for many miles wont flying off — perhaps the Reason why it dont fly off is y: it is surrounded by Elastic Bodies such as Air. how may not the envelopping Membranes of the Nerves be bodies unfit to propagate the Nervous Fluid, & may not this be the Reason why it is confined? for we find y: the greater or lesser pressure

of these ~~enclosing~~ enclosing membranes very
much influence its motions. I offer
all these things as Conjectures but hope
here after to prove them more fully. Another
Question here occurs & y^e is the Ner
Nerves hollow tubes? - Why to this
I answer it is not necessary, to suppose
them such. for the Nerve is so Sub-
tle that it may be propagated as well
without hollow tubes. we before
hinted in w: manner Ligature acted
in stopping its motion.

Of the Nerves

We come now to the second Division we made viz to 2d Thought. I shall consider it as much as possible separate from its Causes viz Sensations, Under it shall include all y. Mental Operations, from volition to all the intermediate Operations between it, & Sensations. You see how very extensive the Subject is! — It is a Matter of the utmost Consequence, and of great Influence in Physic. I shall however confine myself to that wch is most applicable to our present System of Physic.

I shall Begin with Sensation wch is the Foundation of all ~~other~~ other Mental Operations. It is a simple Idea not to be defined.

of the Nerves

When Objects excite Pain in our mind we call it Sensation. it arises in Consequence of motion excited in the Sensorium Commune. it is therefore a Function of the Origin of the nerves.

— do Impressions excite Contraction without the Intervention of Sensation? yes I think they may. for 1. when a Muscle is cut out of the Body & an Impression made upon it by a needle we find a Contraction excited on it. here no kind of Sensation intervenes, for here all Communication is cut off w: the Sensorium Commune, and the Animal has no Consciousness of it. Consciousness is always necessary to Sensation. But 2.: we have other Instances in the living Bodies. thus the Impressions made on the Gutts

by Purges excite no kind of Sensation in the Sensorium Untill the Matter lodged off drives at the Rectum. Some here tell us y: a Repetition of the Embrocation takes off Sensation. - In many Cases this may happen, but in the Instance we have adduced it has no Foundation for it takes place even in the first purge we give. Do: ask him who ever felt a Sensation from the Operation of Diuretics? or even Emetics yet we can Evident Contraction take place w: cannot be resolved into Habit. Cantharides it is true excite Sensation, but they operate on the Neck of the Bladder, & not on the Kidneys.

Another Exception occurs here

ion for the Contraction is succeeded
by a motion communicated, thro the
Senatorium Commune

Are ~~[illegible]~~ Contractions are excited in Glands no way connected by Nerves or Muscles wth the Glands when the Impressions are made, Nor are these Impressions accompanied wth Sensation or Thought? (a) No they are not. I have seen a Stone in the Kidneys excite Sickness & Vomiting & yet the Patients never felt the least Uneasiness in their Kidneys. Many other Examples of the Kind might be added in those Cases wch are called Sympathies. Sensation is connected wth Impression only for the final purposes of alarming us by Pain or allurring us by Pleasure.

I shall now go on to the Motion

of the Nerves

of these Impressions w: do excite Sen=
=sation. Our sensations are different
according to the nature of Impression,
as in the sense of hard & soft &c.. they
are different 2: according to the nature
of the Organ they are made on. This
may depend on (a) the Extremities of the
Nerves being diversified, or (b) upon the
state of the Organ in which they termi=
=nate. Thus we may conceive the Audi=
=tory Nerve w: receive the Light if placed
in the Retina, & vice versa. 3: Impres=
=sions are different according to the nature
of the sensation arising. There is no Connec=
=tion between Impression & Sensation. There
is nothing in Colour 4: gives us any Exact
Idea of their depending upon any different
Refrangibility of the Rays of Light.

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See Dr. Haller's Primaria 556.

This Observation is of the utmost Consequence as we here distinguish Body & Mind from each other, and it is the strongest Argument in Favour of the Immateriality of the Soul. All our Sensations upon which depend upon certain Arbitrary Institutions of our Creator. See no Reason why the Refrangibility of the Rays of Light w: give us ye Idea of a red Colour sh: not have given us the Idea of blue. Sic Deo visum est.

The Laws of Sensation are v: all our Sensations depend on certain Impressions but they are remarkably connected w: the Degrees of Impulse, insomuch as Commotions to change the Sensations. Thus Heat & Cold depend on ye same Impulse

but the sensations they excite are very different. all sensations therefore are as the impulse given, & the sensibility of the part they are made on.

2d – not only force but duration is necessary in impressions in order to excite sensation. all transitory impressions are indistinctly perceived. when an impression remains for some time it excites y: sensation w: we call Attention

3d Law, is that the mind receives but one sensation at one and the same time. when the mind is deeply engaged in one sensation, any future impressions made on the body, excite no sensations. the transition of the mind, is so sudden from one sensation to another that we are apt to deceive ourselves. but if a person y: y: mind can

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have but one sensation at once.

4th. Several Impressions may strike at once when they can unite so as to produce one simple sensation. all these Impressions must be of one series.

Thus the sensation of Green in our mind is compounded of Yellow and Blue. the Green is as truly a simple sensation as the Blue or Yellow. the same thing takes place in sound. the combination of agreable sounds forms harmony. the combination of disagreable sounds forms Discord. I think this Law will likewise hold very general w.th regard to the sensations of Smell - Smell & Taste especially in

there of one kind. It is necessary in all cases of impressions of this nature 1st that they be synchronous - that the impressions be very minute - and duly mixed - 2nd all sensations ~~[illegible]~~ contiguous for some time after the impression is made. Now if an impression is made immediately afterwards, the impressions are compounded & a single sensation excited. Thus if a boy paints his top of a variety of colours & whirls it, all the impressions on the top will unite & produce but one sensation on ye mind.

- This finishes our Ideas of sensation & go on to observe y^t^ they may be renewed by the power of ye soul called

(a) without this we never ch^d. become
acquainted wth Nature, as every new
Impression w^d multiply our Ideas.

of the Nerves

Memory. this is of two kinds 1st
When the Sensation is excited by a
Renewal of the Impression. this is
called Reminiscence (or 2nd: When
the Sensations is recalled without any
impressions which formerly excited them.
- this last of Memory is of two Species 1st
When the Idea is so vivid & distinct that
it was in the Original Impression. 2nd
When these Ideas are as strong & distinct
as the Original Ideas themselves were.
- this I distinguish by the name of
Imagination which renders Ideas so
strongly as to make us imagine the
Impressions to be present which at
first excited them. —— Lud: Hale 2559

of the Nerves

Let us now enquire into the Causes of these Sensations. Why does Reminis-
-cence bring to our minds Ideas form-
-erly excited there? an Answer to this would lead us into very subtile Discussions.

I shall only enquire into the Circumstances w:th attend it. In every Impression we have a complex Idea insomuch y: in all Nature we never find any two things alike. hence y: mind always enquires how far the Impression resembles in all its Qualities the impres-
-sion it had before. w: is the Cause of Memory & Imagination? It depends either on an Association of Ideas w:th a present external impression or upon internal Impressions made

of the Brain

or the Sensorium Commune. This Association of Ideas is called Judgment & depends on certain Relations of Impressions in Position, Place & time: so that from one Impression many Ideas may be renewed: are connected in either of the above Ways. This is the ordinary Cause & Exercise of Memory. But there is another Cause depending on the Impressions made on the Sensorium Commune as in Dreams & Delirium. Dreams indeed often arise from external Impressions. Thus cold - or an over load of Food often cause Dreams, tho' they appear to be somewhat connected w: external Impressions.

of the Nerves

Deliria depend upon the unusual Impulse of the Blood at the Basis of the Brain. in all Dreams & Deliria Imagination is excited rather than Memory. I shall here after consider them as morbid Cases. I shall now take some Laws w: take place in Memory. 1. that no Idea can be recalled to the mind that was not excited by some impression from some Sense of Sensation. 2: all Ideas required by Impression cannot be renewed by Memory. here but those w: are acquired by Hearing & Seeing. I can recollect sounds & prospects, but cannot recall the Ideas of

Smell - Taste - or touch - happy for us we cannot renew the Sensations of Pain. the Ideas arising from smell or Taste can only be renewed by certain signs such as words or sounds w: we have formerly been associated w: them. we only remember w: the sensations were, & can sometimes feel the effects of them as in thinking of Sauerkraut but in these cases we do not remember the taste of Sauerkraut

It is by means of memory we distinguish between wakeness & sound sleep & dreaming & waking. for the waking man in his senses recalls his Ideas in y: train in w: they had been associated w: I would call Coherence in

thinking. Thus when I am seated in my own Chamber ~~I~~ when I recollect my having given a Lecture. I always recall the Idea of this Chamber & of the several Gentlemen: surround me w: their Drap- visage- Employment &c.

Now in Dreams Ah! this subject lie but to my mind my Ideas will be confused, & Ah! perhaps ~~imag~~ imagine this Chamber altered - the Gentlemen who surround me changed in ye: Drap- or visage, or perhaps employed in a different manner than I now see them.

The different states of Memory depend upon the state of ye Sensorium Commune. Memory is located in the Brain. This is evident from Children

who have no Memories till they are 5 years old, or from Bed Persons who forget all late Ideas, but recall those excited early in Life. we see too many instances of a loss of Memory in the middle of Life from morbid affections of the Brain .. 2: Memory is different according to the Nerves w: which the first impression was made as we observed when speaking of Attention. 3: Memory is different according to the novelty or surprise of the Idea first received.

4: Memory differs as Ideas are attended more or less w: reflex sensation that is from being more

or less accompanied wth Pleasure or Pain, or being more or less interesting.
5th Ideas are retained longer or shorter according to their Relation more especially according to the Relation of Time. we forget those Relations cannot wch depend on certain Marks or Signs.
6th Memory will be more or less strong according to the Number of times Ideas have been excited on the mind.
7th Ideas will be recalled according to the Perception of Relation which they bear to no. —

Memories are of two kinds, such as are tenacious of Signs only such as Names or Languages 2nd such as are tenacious of Relations. this constitutes wh^t is called Judgment. a man who

respects this must also respect the former in some Degree, but a Man who has the former to a great Degree generally wants the last, as his Mind is occupied Only w: the external Relations or more Signs.

we come now to Speak of Reflex Sensations

Then all direct Sensations are Attended w: Pleasure or pain. this some have Doubted, & have said, there are Ridiculous Sensations but if there are any they must be very few. the Terms here used viz: Pleasure & pain are liable to Ambiguity in being confounded w: Other Sensations that are painful or pleasing Only in a Lesser Degree, or in

they may be perhaps of another kind. Thus Pain ought to be applied only to y sensation arising from a cutting of a knife, or from any Injury done to the Body.

Uneasy Sensations are such as arise from Nausea &c.

Disagreable Sensations are such as arise from viewing an ugly Picture or any thing of the kind.

The Pleasing Sensations may be divided into agreable - delightful, and pleasant as arising from viewing a beautiful prospect - from Alacrity & from Decency.

Even Reflex Sensation exists to volitional do y: they serve as a chain to connect Sensation & Volition

all Passive Sensations are attended
w: th pleasure or pain & therefore
excite to Action. But before we pro=
=ceed we shall distinguish between Ins=
=tinct & Reason. every Act of ye Will
arises from simple Distinct Sensa=
=tion or from the perception of Relation
- When it arises from simple Distinct
Sensation it is called Instinct, but
when it arises from the Perception of
Relations it is called Reason.
- I shall now take notice of ye Circum=
=stances w: th attend volition, but I shall observe
1: There can be no volition without Sensa=
=tion,
2: no There may be certain motions in the
Body without our Consciousness of

Of the Nerves

them as in expressing our Passions by the Muscles of the Face.

3d: There are Motions attended with Volition wch have been called Volun=tary wch determine us to get Rid of any Uneasiness without having any End in view for this purpose. such as in the Actions of Yawning - Sneez=ing - Coughing &c. some will tell you that we have an End in view in these Actions, but if we have it is only in Consequence of their having been repeated.

4th: There are certain Actions wch depend on Stimuli ych cannot be performed wout them. they are connected with the former, & have no End in view. as

in the Case of our Appetites. Thus we cannot perform the Act of Deglutition (altho a voluntary Motion) without some Degree of Hunger. See a Remarkable Case of this kind in Hildanus.

5th There are Motions which arise not from simple Sensations but are deduced from Reasons & are excited as Means to an End. The former Motions are all Involuntary or Instinctive this last Rational & Voluntary.

of the Nerves

We come now to speak of Contraction. Contraction takes place in certain parts of our System only, from wch it has been inferred yt it depends upon a peculiar Organization of those parts. We shall first enquire whether this Contraction depends upon an Electricity yt is peculiar to them in common wth other matter, & secondly whether this Contractility is peculiar to Muscular Fibres independant of their Connection wth the Brain from their Conformation as Dr Haller has asserted.

As to the 1st Question we may observe yt the Contraction in

Muscular Fibres is much greater than in other kinds of Elastic matter.

2d: Elastic Bodies are Contracted by bending power Alone, but Muscular Fibres are contracted by Substances wch: have no Tendency to bend them but as Stimuli. Muscles upon this Acc: are said to be possessed of Irritability. but I think Excitability would be a better word as the term Irritability Bespeaks pain. we shall however call it hereafter after Dr Whyt Irritability.

3d: All Elastic Bodies when Stretched return Again to their Orig: Length, nor can anything make them contract when

(a) Elastic Matters are capable of Contraction only when in a State of Tension, but this is not the Case with Animal Fibres, for they contract when relaxed, or even when cut out of the Body.

they are in this State of Tension. But all Muscular fibres we know are in a State of Tension at times, & yet are capable when stretched of Contraction. (Ca.)

4: Muscular Contraction is peculiar to living Systems only. hence it is justly called by Dr Gaulrics Vis Vitalis as opposed to the Vis Mortua w: relates to Contraction in simple Elastic Bodies.

— we grant a Muscular Contraction may sometimes take place in Matter w: has no Sense, but then this Matter must have been once connected with Animal Life. —

of the Nerves

Let us now enquire to wh. parts of the System this Contraction belongs. — we know it belongs to all Muscles; but how shall we tell wh: parts of the Body are muscular & wh: are not? — Some Physiologists confine it to all parts that are possessed of Irritability; which I know of nothing to contradict. On wh: Organization does the Contraction of Muscular Fibres depend? — this is a most difficult Question. But before we discuss this we shall enquire whether this Contraction is peculiar to Muscular Fibres themselves, or whether it depends on the Brain? — all Physiologists

of the nerves.

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suppose some auxiliary power such as an Influx of Blood or nervous Other to be necessary to Contraction except Dr. Haller & a few Others. we grant that a ~~muscle~~ Muscle cut out of the Body is a nerve fired to it will contract. But this continues but a very short time. on w: does it depend? on the Mechanism of the Muscle? or on a dentient principle? the last is improbable. we must then admit Dr. Haller's Vis Insita & say there may be contraction without any Influx or auxiliary power. we find Contraction

(a) Lu Primo Lince § 403. & 404

continues even in the living Body when the Nerves are tied w: belong to the contracting Muscles. it makes no Difference when the Muscle is tied. The Irritability is the same whether near the Muscle or the Brain. Thus you see I agree w: the Dr Haller in his notions of the Vis Insita, but differ from him, by supposing y: it depends on y: same Elastic Fluid w: excites Contraction in every Other part of the Body. This differs from the Contractions being the same in a Muscle cut out of the Body whether we touch the Muscle or Nerve w: enters into it. This is sufficiently proved in Dr Smith's Thesis. Frustra fit per plura quod fieri potest per paucioria.

# of Contraction

Contraction does not depend upon any Organization of the Muscle, but is derived from the principium Commune, & flows from it in all the Acts of Sensation & Volition. This is proved 1st from Ligatures on Nerves preventing Contraction in those Muscles they are distributed to. 2d from the fœtus having its part there. This is easily proved from the Fractures of the Fœtus being impaired by an Injury done to the Brain only either directly or indirectly. 3rd from the Renewal of Ideas or the Exercise of Memory which remains after every other part of the Body is impaired except the Brain.

# of Contraction

1st: If a Ligature is made near the Brain, & an Inflammation made on a remote part of the Body no Contraction is excited. 5th We often see Convulsions excited in Muscles whom the Inflammations are made on Muscles in a different part of the Body. This does not depend on any Connection of Nerves, but is occasioned by Motion communicated from the Brain. 4th We all Sympathies are made. 6th We often find Pains complains of Sensations when the Limb in w: they feel it has been long cut off. W: can this depend on? but it shows y: Sensation & Contraction are derived from y: Brain. But to all these Arguments Dr Hunt & Lay that there

Contraction

There are Animals who live & exercise Sensation & Contraction who have no Brains or very Involved Brains. It this I would answer that this Argument is founded on false Facts. many Experiments have shown us Brains in Invertebrate Animals in w^h Dr Haller has denied its presence. But independant of this, we must not confine our notions of Brain too much. it may be extended all the the Medulla Spinalis, & different parts of it may be of more or less consequence in different Animals. Insection & Worms have not only confined to Brain but the Understanding also. this is without from the Brain being the Origin of all the Nerves, 2nd from 4 of the Senses being

seated only in the Head. No ty^e Cases of the Intellectual Faculties being left unimpaired by Lesions of the Brain, I think they are liable to great Fallacy. — an Injury of the cortical Substance of the Brain we know does not affect ye Understanding, nor even slight Wounds of Just the Side of the Brain. Besides I am apt to doubt the Truth of many of the Facts adduced. — Let us now enquire into y^e Mechanism on w^h Contraction depends. a most difficult Subject! & abounding w^h Conjectures w^h show its Obtrusiveness. I would reject all the Facts of these Conjectures w^h suppose Contraction to depend on y^e Motion of

Contraction

the Blood as Ligatures on Arteries suf=
=ficiently demonstrate. See Dr. Haller § 406.
— We find muscular Motion continued
even after the Heart is cut out from
a Frog. This confirms what am advancing
beyond a Doubt. If then any Energy
power is necessary to cause contraction
it must come from the Nerves, even
those who suppose the fluid to be secreted
in the Muscles allow this. Physiologists
have imagined y the influx of spirits
of the Nerves was insufficient for con=
=traction, & have called in a peculiar
Organization of the Muscles to assist it.
But this will not ans: for the degree
or velocity of Muscular Motion.

Contraction

Shall it rather depend upon y^e^ Elasticity of our Nerves being propelled into the Muscles, & overcoming y^e^ Resistance of y^e^ Other wch: always comes not only our Muscles but all Other Elastic Bodies. — a Doctrine this first delivered by Sir Isaac Newton! who explains Elasticity by it, he gives us exact Calculations of the Rarity & Elasticity of their several Others. The Spiral form of ye Nerves wch. Dr Smith has lately demonstrated seems to favour this supposition.

But how are Muscles excited to Contraction when cut out of the Body? to this we answer y^t^ the Other of our Nerves is in a very Elastic

(2) to this we may add y^e all muscles have an Alternate Contraction and Relaxation wch may arise from y^e Tendons of the Other to restore it to an Equili=brium. from this we Aw^r for y^e vital & Involuntary motions.

mobile state, & when put in motion by a stimulus applied to y muscular fibres reacts again & thus excites motion. Besides the Effect of the fibres may have such Oscillations by stimuli as to produce this motion. Here we must say a few thing, on stimuli. all stimuli are Chemical or mechanical. the Action of the first depends on the Difference of Oscillations in the Objects w: excite Parts or Action, for all Bodies have an Effect peculiar to themselves w: hes Oscillations according to the different nature of its Mats. But how do Mech: stimuli act in those Cases where there is no Impulse - Only as Repellents Only. such stim: it must have sharp points & therefore cut by removing the nervous Fibrils

Contraction

from one another. or by the attractive
power going out from them into our
nerves at a point & thus gives pain.
— But how do sedatives act? This is
a difficult question. I formerly supposed
the sedatives mixed w: the nervous fluid
& thus destroyed its mobility. we have several
Chemical Analogies w: confirm this. but
I see many objections to it, & therefore
am willing to desert it. I think a better
explanation may be given. we just now
presumed that sharp pointed stimuli
added to the other of our nerves. now
may we not presume likewise certain
substances such as sedative medicines
have a power of abstracting this attractive
— we have a strong analogy to confirm

This is the communication of the Electric matter to Non-Electrics.

Let us now enquire into the different states of Muscular Fibres. 1st on w. does Spasm depend? wholly on two Causes. 1st on too great an Affusion of the vis Nervea, but why it ceases remain so I cannot say. 2nd on the Stretching powers being taken off from Muscles lying too long in one position. I shall hereafter speak more fully on this subject.

— On w. does Convulsion depend? This has been confounded w. Spasm by Dr. Gaubius & Others, but I think them essentially different & depend on different Causes. If Muscles act w. unusual Force or velocity we say they are convulsed. — if they remain long in a contracted

Contraction

filtration we say they are affected
the
w spasm. a Want of Tension is the
greatest Predisposition to Convulsion.
— This Tension is called tone or tonic
power, & depends upon an Equable Dis=
=tribution of the Nervous Fluid. If this
by any Accident does not flow in upon
any part of the Body an Atonia is in=
=duced. This Atonia differs from Palsy in
not depending upon an Interruption but on
a want of
a compression of the Nerves.

Before we discuss the Laws of the Nervous
System we shall give a short

Recapitulation

Here I would remind w:d ought

Recapitulation

to have done before &c. so that all the Phenomena of Nature are to be explained Mechanically under its different modifications of Pressure & Impulse. We have retarded the progress of Philosophy much by restricting our notions of Mechanism. — The Corpuscularians have endeavoured to acc.n for every thing from the Action of hard Bodies on each other, but later Inquiries have taught us to call in the Action of subtile Elastic Matter w.h evolves many Phenomena in Nature hitherto unexplained; as the Theory of Electricity — Magnetism — Light — Gravitation &c. — Visionary & Lunatical Philosophers

Recapitulation

have ever been found of calling in immaterial Agents which have tended much to check a free Inquiry into ye Operations of Nature.

a Deo intersit se — Hor.

But to come more nearly to our subject. 1st By the Nervous System I understand the Brain - Medulla Oblongata & Spinalis & the Nerves terminating in all parts of the Body together w: all the vesicular Tissues which are endowed w: the same Sensibility & perform the same Office that is peculiar to the Nerves. from this which we may infer the Muscles have ye same function as the Nerves.

2nd We said every part of ye Nervous

Recapitulation

System was connected which we infer from motions being communicated so uniformly all over the Body by impressions made on the part only.

3.rd All actions are carried on by motions excited in the other y.t adheres to our nervous substance. This I infer from all the preceding and Oscillations excited by the Body impressions. Now these Oscillations can only be kept on by the motion of some subtile Fluid in our nerves, for Oscillations can only act by exciting Oscillations. This Other is not only present in our nerves, but is always in an excited state, somewhat analagous to y.e state of Electricks when the Electric matter is accumulated in them. to this Analogous

can this state of irritability in our nerves is kept up by heat as we shall show more fully hereafter.

Recapitulation

must add 4: it is not only in an et:
-ered but Elastic state. &c.

4th The Nervous System is distinguished into
4 parts, wch have each of them different
Functions. The 1st Difference consists in
its Fabrick in being arranged in distinct
Fibres sometimes however arranged
& mixed wth each Other. This therefore in:
:cludes the Medullary part of the Nervous
System. 2nd under this Second Head
I would include the Nerves wch consist
of the same Matter as the Medullary part,
& are disposed in Fibres. 3rd includes
the Nerves Denudated of a Membrane
wch they have in the 2nd State mentioned.
— in this situation they are exposed
to be acted on by the Impulse of external

Recapitulation

Bodies. The Nerves here then are said to be Organs of Sense. ye: includes ye: part of the Nervous ~~portion~~ Fibres w: are denudated of the Membrane ye: is common to them, & so Attatched as to be capable of Extension & Contraction. These we may call the moving Extremities of the Nerves, in Opposition to the former w: are Sentient Extremities

Let us now enquire into their different Functions. To the first then viz: the Medullary part belong Thought or the ~~Actions~~ Exercise of an immaterial principle w: is connected w: the Action ~~of the~~ or Motion of ye: Medullary Substance Only. The Thoughts in the Brain Alone & no where else.

Recapitulation.

This was proved to you at full Length before. The Function of 2d part of the Nervous System viz: the Nerves is only to form a communication between the Sensorium & the Extremities of ye Nerves mutually. The Function of the 3d part viz: the Organs of Sense ~~Nerves~~ is to communicate Sensations to the Brain by ye Action of external Bodies upon them. we may add also to this certain Impressions made internally by the Action of such parts of the Body as are exterior to the Nerves. as the Blood - or an unusual ~~Impulsed~~ Action of the Blood vessels - or by extraneous Bodies whether introduced or generated there. I mentioned formerly

Recapitulation

that Impressions were either Chemical or mechanical. the Chemical you may remember we reduced to the mechanical & called them only the unknown Mechanical.

If we admit Impressions altering the State of Mixture & Aggregation in the Fluid of our Nerves we may then talk of Chemical Impressions ~~being mechanical~~ also. the parts of our Body are all of them Sentient, so y: our whole System may be considered as a Sentient System. Same Impressions act equably on all parts of y: Body as the Multi: Primaeli. Some again act more powerfully on muscular Fibres such as Compressions - &

Recapitulation

Heat & Cold. But there are some sensations w: can be excited only from impressions made on particular parts. this is difficult to be explained. — it may depend on the greater or superadmirable — Exposition known of the Sentient Nerves which occasion their giving different sensations. further there are Nerves connected w: a certain apparatus in their Termination w: qualifies them to admit the impulse of certain Bodies only, as the Eye sight — the Ear sound & the like. This by impression that Life is first Cost on, & I hope I shall prove that

Recapitulation

It is by Impression only that Pleasure is maintained.

The Formation of the 1st part of the System viz: the Muscular Fibres is to serve as Organs of Sense & Motion. as Organs of Motion they are distinguished of a covering they lend in the Nerves. 2nd: they are from their Spiral Form & their Attachment to Other capable of Extension & Contraction in common w: all simple Elastics. 3rd: they are all in common w: 4th Solids in a State of Tension. 4th: they are in a State of Excited Elasticity

Recapitulation

This differs from simple Elasticity, & resound w: an Other on the Retraction or Addition off w: the Action of Sedatives & Stimulants depend.

Having finished my Recapitulation I shall now proceed to speak of the general Laws of the nervous system. I shall speak of Sensibility & Irritability.

All Bodies w: act upon us produce Sensations, this Capacity of having excited Sensations, is called Sensibility. Those Bodies w: excite motion are said to produce Irritation and the parts capable of this are said to

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in proportion of Irritability. There can be no Contraction without Sensation, & it is ~~always~~ in many Cases ~~in~~ exactly proportioned to this Sensation. See Dr Gaubius §190 where he says Irritability is always proportioned to sensibility. See also §174 But this is by no means universally true. Altho it is difficult to point out where they are to be distinguished. — The same Causes do generally produce the same Effects, but this ch: be used w: considerable limitation. Causes are not always simple, but often compound, & the Effects will always be according to the Nature of the Causes.

Laws of the Nervous System

Contraction ~~Sensation~~ is not therefore always proportioned to Sensation, but may be altered considerably by the different states of the Nerves on w: the Impressions are made, & by the nature of the Impressions made. Hence there Foundation for distinguishing Sensibility & Irritability! .. But further 1: Contraction from Sensation ~~too~~ arises from volition. But we often see Contraction without volition.

2: we see Sensation without Contraction as in paralytic limbs w: depends on a want of Irritability.

3: ~~Offtimes~~ there may be ~~Sensations~~ & no ~~Contraction~~ Sensation from a want of

Laws of the Nervous System

Tension in the muscles the 1st Nerve being given. This is illustrated by taking up a light weight after having bore a heavy One. a trembling and weakness will always in this Case be felt in the hand. There may be grant Causes wh: act on the whole system wh: act alike on Irritability & Irritability. When this is the Case I call it Mobility. When there is a Defect in both I call it Inertia.

But when external Causes act on the Sentient parts only we say here when the parts are too Sensitive, yt there is an Excess of Irritability. Then Sensations are dull & not proportion

as a Case of a Young Woman whose
System from sundry Causes was suspected of
an Excess of Irritability. Transcribed Com:

Laws of the Nervous system.

to Impressions we say there is a Torpor. But when external Causes action the power of Motion only so as to carry it to an Excess we call it Irritability. Where it is Defective we call it Torpor. The Case Van: = Swieten mentions was not owing to an Excess of Sensibility but of Irrita: = bility which Infer from the Cure y: was used to her w: was restoring the Tension of her System by Bandages.

Shall now speak of a: Law of our System viz: the power of Custom & Habit w: have been so much Observed in our Animal Oeconomy

Laws of the Nervous System.

The Effects of Custom are the Effects of a Continuance of the System in the State, or of some new Law or Action depending entirely on Custom. These Effects when indeed are called Habit. I shall consider these as effecting 1st Sensibility & 2nd Irritability

1st Sensibility. We shall remark 1st That all Sensations are more or less acute as they have been continued for a longer or shorter time. A late ingenious French Gentleman found means to distinguish some from other stones ~~and~~ by their shining in the dark which he did by

confining himself for some hours in the Dark before he viewed them. — From hence we learn y^t our Sensations are no Measure of the State of things around us. ~~opinion~~ this is exemplified by the Sensations of Heat & Cold differing according to the Degree of heat in our Bodies. this in my Opinion furnishes the strongest Argument for the Frigorific as well as the Calorific particles. the different Sensations of Heat & Cold Betho^n Cont different Degrees of the same Quality, derive

as both Heat & Cold produce the same direct Sensation but different Reflex.

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further to illustrate to us the Arbitrary Connection between Impressions & Sensation. 1st Agreeable & Disagreable Sensations often arise from the same Impression as in the case of Light. But this will often depend upon the State of our Bodies, so that the impression may in one sense be said to be relative. But there are other Impressions which are Absolute. it is of great importance to distinguish these two kind of Impressions. Heat & Cold are marked by the Body according to its own sensations. thus all Heat

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becomes uneasy beyond 62, & all
Cold excites uneasy Sensations that
is below 32°: Absolutely speaking,
but the Sensibility of the System may
be so altered as to render these degrees
of Heat & Cold relatively painful.
— thus a Man who has long been used
to 80° of Heat feels the Sensation of
Cold if the Heat falls suddenly to 70°;
much more than he does who
lives in a Climate where the Cold
sometimes falls suddenly from
60° to 50° — hence we see the

as big: in being colder

" by assume a virtue if y: have it not

" y: Monster Custom, Who all sense doth eat

" of Habits Devil, is angel yet in this

Refrain tonight

" & that shall lend a kind of easiness

" to the next abstinence, the next more easy

" for use can almost change y stamp of nature

" & master even the Devil, or throw him out

" with wonderous potency. ——

Shakespeare's Hamlet

Law of the Nerv. System

Fallacy of Dr. Worthingham's Ob-
servations on Epidemic Diseases
who supposes that Hippocr: Doctrine
will hold good in Britain altho
its Climates differs so much from yr.
of Greece. 3d Impressions become
insensible according to their Repetition.
— Thus some Impressions we are at
first painful after a while become
pleasant as in the case of Tobacco,
— Spirituous Liquors — Odours &c.
This admits of great Application
in Morals as well as Medicine.
— Brandy becomes necessary if

(a) This is a wise Law in Nature
that serves to defend us from many
things, yt would otherwise injure

we have been long and tiresome
purpose to keep upon Tension in y.
Nerves & a want of which is atten=
=ded w: Lassitude. The longer we
use Brandy the more we require of
it to keep up this Tension. This
leads me to speak of y. Operation
of Medicines. Vomits & purges con
their Force by being often repeated &c
4: Sensations arising from Comparison
are more or less acute as they have
been repeated. Thus a Lemonade
=ser is able from being so long

Law of the Nerv: System.

used to handle Cloaths to tell the moment he puts his Finger on a piece ~~[illegible]~~ at Arm its Degree of Linen &c. — This Law belongs rather to Physi=cians than Custom.

5. any two Sensations by being exci=ted together are ever after connected. hence arises the Association of Ideas. This Association doth al=ways depend upon Repetition but upon the Relation of things also, and on this last kind of Association depends the most useful ~~kind~~ Species of Memory. — Artificial Memory depends on the first kind of Association.

6th Repetition not only renews two Ideas, but a succession of them, and establishes an Order in them. This is exemplified in a Boy repeating certain words he dont understand.

7th Repetition associates Impressions & Actions. This is nothing else but the former Law. The Impressions here act as a Stimulus, & excite to Actions. Thus the voiding of Urine depends upon its Stimulating the Bladder, but we can discharge it at times by renewing the Impression without the Stimulus, as in going to Bed even in those Cases where we have made

Water but an hour before.

8.r The Renewal of Ideas is however much limited, we ~~are~~ only
new Ideas y have been acquired
by Hearing & Seeing, & these can be re=
newed only by certain signs which have
a power of exciting reflex sensations
& thus producing pleasure or pain. Thus
a person who sees a Cup from which
he took a vomit often feels a nausea
& sometimes vomits from it.

I shall go on to mention the laws
of Habit which belong to Instinct
or Imitability.

The 1:is that the Repetition of

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Actions has great influence upon the Tension of our Muscles. Thus a Man who has long been used to carry a weight is not able to leap to any considerable distance without some Load in his Hands.

2nd a Repetition of Actions gives us a greater facility in them. The most difficult Actions become easy by Repetition: it generally attends those Actions w: depend on the Stimulus which arises from an increased Irritability in ye moving Parts. This does not contradict ye Law we mentioned under the Head of Sensibility. — we often see Sensibility diminished & yet Irritability increased. They do not however observe any regular Laws,

Laws of the Nervous System.

& it is hard to tell when they mutually
take place.

3rd: Actions frequently repeated not
only become more easy but spontaneous
& arise without those ~~[illegible]~~
sensations or volition formerly attended them.
Respiration was at first a voluntary
action, but in consequence of frequent
exercise becomes involuntary & goes
forward in sleep. in this case Irritability
increases while sensibility is diminished.

— But is there not here an Effect without a
Cause? — viz: Irritability ~~[illegible]~~ or action
without sensation or volition. No.
— There is always a Cause in these cases,
i e a stimulus or Impression affecting

Laws of the Nerv: System.

the Lungs. whom this Ner: I think we ought to reject the word Spontaneous, from our Theories of the Nerv: Oeconomy. — The Action in Respiration is therefore entirely Mechanical. hence no Consciousness ever attends it. I do not suppose this Function was Originally Mechanical — we know y: Sensations & Volition are Obliterated by Habit, and as this is y: Case we cannot tell w: Actions were Mech.l and w: were Voluntary as the transition generally happens in the Stated Infancy. Even the Heart its self may have been originally under the Command of the Will. We certainly exercise a power over it in many Cases as in Several

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of the Passions particularly in Anger. — The Motions of the pupil & Iris were originally voluntary; & action & volition being obscured or lost by the frequent stimulus of Light upon it.

4: Repetition gives Force to Muscular Contraction. If Muscles are exercised too violently & suddenly it gives Lassitude & Debility, but if gradually exercised & not too much violence they become strong. You have all heard of the story of the Man who by lifting a Calf every day was at last able to lift it when it grew to an Ox. — Exercise serves to apply nutrition ~~Nutritive~~ & grow the nerve & muscles are

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are exercised the more nutrition they derive. Frequent Exercise may likewise give a more excited state, or more Density & Elasticity to the Nervous Other.

5th: Repetition regulates & determines the Degree of Muscular Contraction. The Rope: Dancers & Tumblers acquire their Agility entirely by Habit. The Degree of Velocity in Actions is determined by Habit. The Duration of Contraction is likewise determined by Habit. We can't keep certain Muscles in a contracted State Above a certain time. I cannot hold my Breath Above $\frac{1}{20}$ of a Minute without feeling pain, but Divers

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& Trumpeters can retain their Breath for 2 minutes without feeling the least uneasiness w: is entirely owing to Habit. Lastly the Degree of Tension in Muscles is regulated by Habit. These Laws ably to internal as well as external Actions.

6: Repetition associates motions. as for Example. The Motions of the two Eyes. The Actions of the Hands & Feet often becoming mechanically associated merely in Consequence of Habit. 'tis wonderful to see how uniformly these Associations take place in human life. — The more than two Sensations & Actions may be associated together, but

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They always succeed One Another in a regular Order, as in the Case of repeating certain words committed to Memory. – This regular succession of Impressions or Actions may be interrupted by a sudden Fright or any Thing of the kind, but he who is able to keep up his Train of Thinking or Acting in spite of sudden Emergencies is said to be possessed of Presence of Mind. This Law greatly influences periodical Motions. Thus about 9 O Clock every Morning I think of coming to the College to lecture to you without hearing the Bell strike or the Bell ring. You have all heard of the famous Fox at Sandwich

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Idiot recorded by Dr Willis who had long been in a Habit of repeating after the Clock the time of day, [redacted] incorrectly. When the Clock stopped he continued regularly to [redacted] tell the hours.

How shall we explain all this? – Why our Animal Oeconomy is perpetually subjected to periodical Revolutions from the State of the heavenly Bodies & its own particular Nature. Thus if I am roused from Sleep for a few Morns: at a certain hour, I soon acquire a Habit of waking precisely at that hour. Our Bodies are in a constant Flux. Fluids are perpetually flying off from it, hence arise regular times

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of Relaxation & Contraction, & of Sleeping & Waking. These are called Natural Periods & occur either daily - weekly or Annually. But these Causes are not always simple & uniform. we are subject to many Habits which observe no exact Period, as the falling of Flesh or Eating, w: h have their Regularity often interrupted by Exercise - over Eating & the like. Where shall we look for the Causes of these Periodical Habits? - why in the Nervous System Only. Hence we find all those Diseases which are Periodical are more or less Ner: - vous. to conclude I add that Our

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System is made of periodical Habits, & hence the Reason why Artificial Cures are so easily induced.

This finishes the Consideration of the Laws of Custom & Habit. it is a subject of great importance in Physic, but more especially so in the Conservation of Health. hence Celsus so wisely cautions us Ag: the power & Influence of all Habits, which says is Often to many occasional Causes of Diseases. I know a Lady who from being confined for a few weeks to a dark Room for an inflamed Eye has not been Able to bear the Light of the sun for some years.

Laws of the Nerv: System.

I might easily illustrate the ill: con:
-sequence of Habit on Irritability as
well as Sensibility. Celsus even goes
so far as to recommend Vespers at
times to guard ag:st the Effects of Habits.
But there are some Habits w:ch we should
endeavour to acquire as those which
tend to diminish the sensibility of the
System especially w:th Regard to Cold,
but the Acquisition not only of this but
of all other Habits sh:d be gradual. for
upon this Acc:t could it be possible f
ever w:d suffer Children to taste alco:
-hol food till they were 15 or 16
years old as it acts as a stimulus, so

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thus tends to wear out the System.
in a word Habits wh: be avoided by
healthy Persons, but they become
absolutely necessary in weakly Persons.
it was only by Habit - ie by living by
Weight & Measure y: Lewis Cornaro
prolonged his Life so long.

I shall now go to mention those
Causes, Circumstances & Conditions
wh: influence the Nervous System in
Sickness & Health. I shall therefore
1: speak of those Causes Circumstances
& Conditions wh: influence the System in
general, &
2nd: upon those Causes, Circumstances

& Conditions which influence the Ner:
vous System as divided in the manner
before mentioned.

I: The State of the Whole System will
depend upon Mobility & Inertia i e
when the Causes affect Sensibility &
Irritability, or act upon the Other
of our Curves. The Mobility of ye System
will depend upon the Mobility of the
Other which may be affected by a vari:
:ety of Causes as (a) 134 the State
of the Original stamina. hence we
find different persons who live upon
the same Aliment in Quality and
Quantity have different stamina

Conditions of the Nerv: System

& from this a different state of Mobility in the Nervous System. The difference of Temperament & Sense may depend upon this Cause. I said before that the Otter of Bodies was different according to the Aggregation of these Bodies.

now our Nerves from their original Conformation may be softer than they ought, hence the Density of the Otter they contain may be lessened. the Elasticity of the Otter may also be diminished or encreased which will give Inertia or Mobility.

(b) the Otter of our Nerves may be affected by the powers of Heat & Cold. — we shall enquire in what manner

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they operate hereafter. it is certain they both act on the Other of all other Bodies. Animal Life we know depends upon a certain uniform degree of Heat — may we even dare excite Life even in the Case of Incubation till the generating power of Heat in the Animal is established. if Life then depends upon the motion of this Ether we are sure Heat may give more or less mobility to it. Heat then presumes greater mobility, & Cold Inertia. Infer this from their analogous Operation on the Air. Heat we know gives Elasticity, & diminishes Density, while Cold gives Density, but not Elasticity

in proportion. Cold I know acts as a stimulus; but we before limited that many bodies might act as stimulants & sedatives. But why is not the Body heated in proportion to the external heat applied? The Heat of the Body is uniformly at 98°: nor is it increased by a Heat of the Air that rises up to 120°: Dr Lee found by a number of Expts that the Heat of Drugs was always below the Temperature of ~~their bodies~~ water or the atmosphere. The solution of this Problem is very difficult! Nor does the Heat of the Body fall in proportion to external

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Cold. The generation of Heat ~~&c~~ or shall say Nerves depends upon the Oscillations of our Nervous Atoms: cannot be affected so as to produce more or less Heat by Heat or Cold. an Obvious Analogy borrowed from Electricity may serve to illustrate this Hypothesis. Sulphur is an Electric Body while hard, but no Conductor does it become soft than it loses its Heat & then transmits the Electric Fluid. all Heat above 62° by encreasing Elasticity gives Mobility. all Cold below 62° gives density to the Atoms & hence induces Inertia. This is confirmed by the different Temperament of people

in warm & cold Climates.

(4) The Mobility of the Ether may be affected by certain [redacted] Applications such as Sedatives & Narcotics, which act on the Sensibility & Irritability of the whole System from w: Simply it acts on the Ether & not on the solid part of our Nerves. I before hinted that Sedatives act by abstracting Ether from our Nerves. But Sedatives are of various kinds. Some of them may act more immediately upon the Mobility of the Ether in Consequence of Mixtures, as Acids & all corrosive Substances w: Abstract from Dr Smith's Physic. I much doubt whether these

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are any substances w: produce an excitement of y Other.

2:nd Come now to take notice of the different states of the nervous system. They will depend (a) upon the different proportions of the nervous Other to y: simple solids. hence arises the Difference of Temperament in different Ages. the Medullary substance of the nerves is subject to Changes. this is evident 1:st from the difference of solidity in the systems in Infancy & Old Age. 2:nd from their being extended in length during their Growth. 3:rd we know that

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The Tension of the nerves depends upon the Wall and they have with the simple solids. now we know the simple solids are cumbering in Density & solidity, from whence it follows that the nervous Fibres must keep pace with them in their Growth. from all this it follows 1st the nerves & their Other are suffering Changes thro every stage of Life, in Mobility - Elasticity & Density. from this we explain the Reason why the Memory changes so much. in Infancy the nervous Other has great Rarity but little Elasticity. & hence has

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Small Oscillations, in Manhood &c Elasticity & Density are in their perfect state. in Old Age they are diminished & hence the memory fails.

Let us now explain in what manner the mobility of the Eye lens is affected by this Ballance between the vis Nervea & the limple solids being destroyed. it will depend 1st upon &c height appended 2nd upon the contractility of the simple solids. the height & Contractility of the solids are always on &c Menace from &c; we infer the power of the vis Nervea must encrease also. how

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these do not always agree in proportion
w: must give a difference of Mobility
to the nervous System. at a certain period
in Life they both come to a Ballance. when
the Body ceases to grow, the vis nerve a
continues to encrease in density &
Force. But we know there are many
causes w: induce Rigidity in the solids
insomuch that they overballance
the vis nerva as in Old Age. this Bal-
lance we have been talking on may be
affected by all those Causes w: influence
Tension.

(b) the state of the vis nerva maybe
affected by the Force of distending Fluids.

Conditions of the New System.

- The Arteries are always distended w: the blood w: not only gives a Tension to the Fibres of the Arteries but to Muscular Fibres in General. now the greater or lesser Influx of the Blood will influence the State of Tension in the ~~Blood~~ Nerves. this Influx will depend upon the Force of the Heart, which during Infancy & Childhood is superior to the Resistance of the Solids, but this superior Force is constantly decreasing till it comes into an exact Ballance w: the rest of the System at which time the Growth of the Body ceases. in Old Age the Force of the Heart is inferior to the Resistance of

the solids from whence arise a different state of irritability in the nervous system.

II. We shall now proceed to speak of the Conditions of the several different parts of the nervous system, & 1: we shall speak of the Sensorium w: we shall consider as the vis Animalis from its functions continuing during sleep & waking. These alternate one another very regularly every 24 hours, & are common to the whole Animal Species. The common explanation of this is, y: the nervous fluid is secreted in the brain w: is dissipated during the day by the vis Animalis, and renewed again every night. But to this

Conditions of the new: System.

we object that this Fluid is often expended much faster than it could be secreted. Dr: Power have insists much upon the glandular structure of the brain & hence includes that some Fluid must be secreted there. — this I will not deny: but I hope we shall show hereafter another use for the glandular structure & secretion w: goes on in the brain, & that it cannot possibly be designed as the medium of sensation. for w: we said formerly the Ether is too subtile to admit of such a secretion, nor do we ever find any receptacles w: appear capable of containing such a subtile matter in the brain. But I add, that the Phenomena of the System in general,

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and especially of Sleeping & Waking are
by no means reconcilable to an Alter-
-nate Exaustion or Repletion of the
Nervous power. Its Inactivity may
depend on many other Causes than
an Exaustion of it such as want of Stim-
-ton & too much Rigidity in the Solids &c.
— the vis Insita remains so long in
a Muscle that we cannot reconcile
it with an Exaustion of it. Besides
we see the Otter returned to the Brain
to communicate Impression & not
expended. I grant the vis Insita shows
a weakness by Exercise, but this
arises from a Diminution of the
its excited State, & not from its

Conditions of the nerv: System

being exausted w: we prove from our being capable of exciting it when most languid by Exercise.

Let us now attend to the Phenomena of Flux. here indeed marks of Exaustion appear, but we find Stimuli capable of banishing a Disposition to Flux. These Stimuli cannot communicate Motion to our nerves as we said before, because we find mechan: Impulses such as found are capable of keeping it off. we have a practice of pricking writhes to extort Confessions from y: in this Country, by which means we have kept them Awake Several weeks

now in these Cases there could be no Re=
=pletion. Besides if Sleeping was unavoi=
=dable in Consequence of Transition
why is not waking the Consequence
of Repletion? - for we find it is not,
- we are all capable of sleeping at
any time in certain Circumstances of
Darkness - Silence &c. all the other
Sensations when full, excite a Stimulus
to discharge themselves, but we see
nothing of this kind in the Nervous Stim.
- for waking when no only in Consequence
of Habit or Stimuli applied to ye Body.
we often see Instances of Somnolentio
can sleep 18 out of the 24 hours.
— Now shall we Acc^t for y^e Return

(a) we ought first to define Sleep: it is a Cessation of the animal Function

Conditions of the Nerv: System

of sleeping & waking at periodical hours?
This they do, let our dark great Fun=
-ning or Exercise have preceded. Surely
therefore no regular Function can take
place in these Cases. Has periodical
Habits depend on an Association of
Ideas ~~[illegible]~~ or an Absence of Simili
& not on an Function of the Nerves
Other.

But again we see some Animals
sleep the whole winter - here the Tem=
-perature of the Air only can act on
the Other. it is absurd to suppose a
secretion going on in their Brains
during the whole winter.

Can w: then does sleep depend? on
an Interruption of motion either

Conditions of the Nerv: System

1: on the Sensorium 2.nd on the Mobility of the Nerves & 3.rd Want of Impulse. — — —

I.st let us enquire into the different states of the Sensorium & its influence Cause. here we may include, three possible Causes. 1.st the Sensorium may be in such a state as not to transmit Motions 2.nd Supposing the Motions continuing free in the Sensorium & ever chuse the mobility of the nervous Fluid, or 3.rd on a want of Impulse on the nerves. let us consider each of these separately. as to the 1.st we often see a Loss of Sensation to follow

Conditions of the nerv: System

a Compression of the Brain whereby an Interruption of Motions was in=
=duced. ~~no doubt not that no bad~~ Some suppose that
a light Compression of the Brain always takes place in natural sleep. this
it must be a Compression of a peculiar nature or else it could not have remo=
=ved so suddenly upon waking. Upon the whole I am apt to conclude Com=
=pression can have no Influence in indu=
=cing sleep. sleep may be not only Conse=
=quence or Tumor in the Brain, but we cannot suppose sleep is occasioned by either of these in its nat: state.

I grant the Recumbent posture

Conditions of the Nervous System

does contribute to bring on sleep but not by sending more Blood to the Brain, but by taking off irritability & diminishing the Action of the Muscles.

2nd Cause. viz: the Immobility of the Nervous Fluid. now we know sleep may be brot on by such Causes as induce an Immobility in the Otherwise the Nerves, such as 1st Cold which sometimes brings on a sleep of Death. - We always find it acts by inducing sleep first, & an Insensibility of the Nervous System. the sleep of the sleeping Animals is brot on entirely

Conditions of the nerv: System

by Cold. this we infer from their being so easily revived by warmth. this Transfusion tried upon a Batt with the most desirable success. Heat then must act by restoring the mobility of the Batt, & after that the irritability of the System 2nd Narcotics act by destroying the mobility of the nervous system. some suppose they act on the mass of Blood so as to thicken them, others say they rarefie the Blood & thus cause it to compress the Brain & so induce sleep. But we have many facts w: shew us that they act directly upon

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the nerves, & yet too in proportion to the Sensibility of the part they are applied to. I infer then that they act solely by destroying the Mobility of the Nervous Fluid.. in whatever formerly hinted. But Neither of these Causes can act in inducing Natural periodical sleep. we must therefore seek for the Cause of sleep in the III: rd set of Causes viz the want of Impulse only. this appears to be the only true Cause of Natural sleep. you may make a Person fall asleep at any time

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by removing all Sensations or Stimuli from the Body and Agitation from the Mind. We often find an single Impression will bring on Sleep which must be by taking off the Attention of the Mind from any other Impression. a Beauty Prelude induces Slumbers only by occupying the Attention of the Mind or Stomach in Digestion.

— The Animal System is no Automaton but requires external Impulses to keep it in Action. The Other is always aiming at an Equilibrium, but internal Pulses destroy it, now when Organs

(or) the waking State appears to be
a State of violent kept up by stimuli.
Sleep appears to be the rest State of
the System to which it is always tending
- these stimuli are the Causes which
keep the sensorium always in an ex-
=cited State.

Conditions of the Nerv: System

removed an Equi librium or Rest is brot on which tho it does not induce Sleep itself, yet it disposes to it. as the Animal System requires to be constantly excited, & without Impulse Life would soon be extinct. there must be something always to Rouse the Other in an excited State in work=ing in the Brain, now when all Stimuli are removed the Brain collapses, or acquires a State of Im=mobility. it is easy now to conceive why the collapsed State of the Brain or Sleep succeeds a want of Impulse. – all this corresponds strictly with

Conditions of the Nerv: System

the manner in w: Pod & narcotics produce artificial Sleep which I imagine to be by destroying the mobility of the Other & not by raising w: it. But a difficult Question arises here. Why does a Disposition to Sleep always follow Exercise? Why not Exercise act as a Stimulus & thus put off Sleep? — This must be referred to a certain Law in our Constitution. Exercise when the Other is in an excited state diminishes its Excitability. Thus all Stimuli we know after being long applied, lose their power of exciting Motion, w: is owing (not to the Fluid of the Nerves being exausted) but to its Excitability

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being destroyed. Now all Excess, whether of Body or Mind act in my Same manner. This in my Opinion solves the Difficulty we proposed. What does Sleeping depend on? 1: on the Circulation of the Blood in the Brain, & a moderate Degree of Tension always keeping the Other in a relaxed State. This is the Reason why an increased Action of the Heart, or cold Feet prevent Sleep by determining too much Blood to the Brain. There is Another Cause of Sleep 4th w: we did not mention viz: Heat. This when carried beyond Ch: actas, produces

(a) the Excitement in this Period so high as to resist Impressions.

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either by taking off Tension, and lessening the Generating power of heat in the Body, or by acting on the Surface of the Body only by Receiving Blood from the Brain. Let us now enquire into the different Degrees of Excitement in the Other. The highest Degree of Excitement is in Maniacs. Some their Tremendous Strength & their insensibility of Cold. This is the most opposite Degree of Excitement to sleep. The 2nd Degree is ye w^h occurs in the Ordinary State of waking. This Degree may be subdivided at several times according to the bigor or debility Gaiety, or

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or Melancholly w: Persons fall when Awake. a 3d Degree is the state of Sleep. this also is different in Degree. thus those who dream have some of their Animal Functions perfect this then is still a Degree of Excitement. + there is a constant Energy from the Sensorium in the waking state into all the Nerves. now in Dreams part of the Brain may remain unexcited, & those Animal Functions wh: we see may proceed from that part of the Brain from whence their Nerves are derived nothing collapsed. all those Actions were

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mit during sleep nervous fatigue now is owing to their not being attended w. sensation or volition. This is the Reason why the Heart is he never tired w. its beating. a 4th degree is Syncope.

a 5th is Death. Syncope depends on a withdrawing of the exciting powers as the Action of the Heart & Arteries on the Brain. This we prove from being prevented by keeping the Body in a recumbent posture Death depends on a Collapsion of the Brain while the rest of the system remains unhurt. This

is evident in that Death was brought on by Fear or Joy when in an Excess. I think we might bring all the other Causes of Death to the same principle. I shall now mention the Several exciting & collapsing Causes of the Brain. The 1st exciting Cause is Heat. This we prove from the Sleeping Animals being colder in Winter than in Summer. 2nd Cause is the Action of the Heart. 3rd The Exercise of all the Vital & Natural Functions. 4th The Tension of the different parts of the System Defined = Ding

(a) This is somewhat doubtful?

Conditions of the New: System

either on the solids or fluids. this is evident from the unalterable Effects viz: the passion of Lower one foot has when rendered tense by a full section as the seminal vesicles.

a 5th Cause is, all the sources of Sensation I mean direct sensations

a 6th Source is Reflex sensations or ca those w: are attended w: pleasure or pain.

a 7th Cause may be a certain Condition of the Brain altho' we cannot pretend to explain it.

a 8th exciting Cause is Sleep. I said before that waking is a state of violence, kept up by stimuli. now Sleep puts the System into a more

(a) Upon this subject see Dr. Gaubius
§ 523. & 524

Conditions of the Nerv: System

excitable State & restores the Equi=
=vitability of the Other. Let us now
enquire into those Causes which take off
Excitability & bring on Sleep.
The 1st is Cold. The 2d the weakned Action
of the Heart 3d: The weaken Action of
the Vital & Animal Functions.
4th any thing y tends off Tension.
5th The Absence of ~~Lues~~ Sensations not established
necessarily by Habit, for the Absence
of those excite the Brain.
6th ~~Sedative Ef~~ direct Sensations.
7th Sedative Impressions.
8th ~~direct~~ same Sensations y are reflex ?
9th Exercise. —
10 Compressions of the Brain. (a)

Conditions of the new: System.

We come now to speak of the different states of the Nerves as involved in their particular membranes. They are liable to the Conditions of being more or less fit to propagate motion. We know of no causes that can influence these but compression from Tumors or other causes. Compression may vary considerably & thus produce different Effects as in the numbness w: arises from compressing a nerve and in a total Compression.

We go on to speak of the different states of the Sentient Extremities. These are greatly varied, but depend more upon the apparatus contrived for receiving Impressions than

Conditions of the Nervous System

upon the different state of the nerves, — But the nerves are more or less sensible, as depending upon Habit — 2d: upon the state of Tension in Muscles from distending Fluids. an over-Tension we know increases Sensibility as in the Case of an Inflamation of the Eye. I will not pretend to say a want of Tension diminishes Sensibility.

3d: Upon the different states of Energy in the Sensorium. When this Energy is very strong it diminishes Sensibility & lessens the Force of Impressions as in the Case of Maniacs.

4th: Upon the Mobility of the Nervous Fluid wh: we know differs in Temperaments

Conditions of the nerv: System

Ages & Sexes, It may be varied likewise considerably by Poisons as in the Hydrophobia. we know of no stimulants that act directly upon the Sensorium, the only stimulants that act upon or excite the Sensorium are Sedatives such as wine & Opium.

Let us now enquire into the Conditions of the moving Fibres. their greater or lesser Irritability will depend first upon their Organization by wh: I dont understand any difference in the ultimate Fibres of these Muscles, but a greater Irritability of them. this we see in all those Muscles wh: are moved involuntarily, It is occasioned this by their being formed sooner than the Organs

Conditions of the Nerv: System

of the Natural Functions. the vital Organs retaining their Irritability after Death while the Other Organs loose their Motion depends entirely upon the different Circumstances of Rest & Flexibility. the vital Muscles are moreover less connected w: cellular texture & consequently their Actions will continue more free after Death.

2:nd upon Repetition w: always increases Irritability w: may serve still further to Cur: for the Heart retaining its Irritability longer than any Other Muscles after Death.

3:rd upon the Muscles being more or less exposed to various stimuli which give a greater or lesser Excitement to the Other.

Conditions of the New: System

4th: Upon their greater or less Tension
— When the Tension is increased too
much it excites the Sensorium.
depend upon 1st: This Tension may the Ballance between the
Sensorium & the moving Extremities
as we said before in explaining the difference
of Probility in different Ages. 2nd: Upon
the Ballance between different Muscles
especially those which are Antagonists.
— Hence we see the Reason why an
Etonic follows the want of usual Stimulus as in
the case of Dram-drinking — lifting
weights &c which act by bringing on Tension
& the Ballance between the Muscles.
5th: Upon the Probility of the Nervous
Fluid, hence we often (tho' not always)
find it proportioned to Sensibility.
6th: Upon the Tension of the Arteries

Conditions of the Nervous System

which have no thing * to act against them but the Blood. Their Tension therefore will depend 1st upon the Quantity of Blood in the Body - 2nd upon the Difficulty of its Distribution - 3rd upon the greater or less Resistance of the veins, 4th upon the Force of the Heart 5th upon the Resistance of the Arteries of themselves.

Tension therefore varies in the Arteries in different stages of Life; as we explained at some length formerly. 6th Upon the pressure of the surrounding Atmosphere, 7th upon the Changes of Heat & Cold. 8th upon the Determination of the Blood to the Surface of the Body.

From what has been said concerning

Conditions of the Nerv: System

The different states of the Arteries we may readily see the Cause of a Plethora which depends upon a laxity of the Arterial System which gives way to the Accumulation of Blood. When this is the Case the irritability of the System is increased & hence arises the Frequency of Haemorrhages in Plethoric Persons.

I go on to speak of the Changes of the Alimentary Canal & 1st of the Stomach the Tension of which depends 1st upon the state of Energy in the Sensorium 2nd: upon the state of the Distending powers 3rd: upon the Stimulating

Conditions of the Nerv: System

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forces applied to it. in a great degree
of Energy from the Sensorium is ne=
-cessary to the stomach so y^n general
Changes in the nervous System have
a power of influencing its Tension.
2nd: It is surprising to see w^t different
states of Tension it is capable off from
Aliment taken in. the Blood wch it
contains likewise tends to influence
its Tension considerably as it is more
or less in Quantity.
3rd: Its Tension is much varied from
Impressions made on it as a sentient
& irritable Organ by the great

Conditions of the Nervous System

Variety in Food - Medicine - & Other things acid entirely taken in. Upon y: whole the Stomach is subject to the greatest Changes in its State of Tension of any part of the Body except the Pendorium, & has the most extensive Connection w: the rest of the System. w: has been said of the Stomach will Apply to all the Intestines.

But Again the Muscular Fibres of y: Bronchia are capable of great Variety in their Tension from Changes in the Air & Other Causes. in a word, every

Conditions of the nervous System

hollow Vessel in the System is liable to have its state of Tension varied by some of the Causes we have mentioned, such as the Glands - Lymphatics &c. But these cannot be the subject of our Inquiries here. I must leave them to your own ingenuity. -

We come now to treat of the much talked of Sympathy. a Term, y^t is often used with Ambiguity!

The nervous System is a continued Chain of Matter by w^h means it is adapted to communicate Motion

to all its different parts. This is wh. has been called Sympathy, & has been resolved into some inexplicable Connection between Ear & Another. Whenever enquire into the Cause of Sympathies we shall find they evidently depend upon a Communication of Motion. I observe then that Sympathy has been distinguished into General & Particular. By the first I mean those Communications of Motion wh. affect the whole System. - Thus Epilepsy is supposed to excite General Sympathy from the degree of Stimulus wh. brings it on, & not

Of Sympathy

from a general Relation between the part impressed & the whole — thus the sight or touch of a person indues Paleness, not from any Connection between the parts affected but from a Communication established in the Brain. in all Cases of this kind & which the term Sympathy is improper, as the Parts are sensitized all depend on nothing but a Communication of Motion. But when we see Motion excited in one part only pretty uniformly by the same Impression we call this particular Sympathy. — thus the Slider of a File very

Resent & reject from Lambeth all those
w^h arise from Imitation, such as
Yawning from seeing another
Person yawn: &c

of Sympathy

uniformly excites an uneasy sensation in the Faith, & could but in some constitutions very generally induce a folie. But may not all particular Sympathies be reduced to the general Sympathy? I believe there are few of those Sympathies enumerated by Dr Whyte but w: may be reduced to this head. 2d: We reject all those (a) ~~Sym~~ Motions w: ch are the Consequence of Relict & Association from particular Sympathy as many of them are Arbitrary & may be laid aside at pleasure. But again I reject all those Motions from Sympathy w: ch succeed & those

# of Sympathy

produce one another. thus we often see the Oesophagus affected wth a Spasm from an original affection of the Intestines being propagated upwards without any kind of Sympathy. all the particular Sympathies may be reduced to General Sympathies & depend upon an affection of the whole nervous System, as we see some of them brot on by a variety of different causes. thus we find a Lockd Jaw brot on by a wound in any Limb of the Body. Sympathy means no more than a <u>mutual Action</u> between the Several parts of the System. wch implies & Exists itself without assigning any Cause.

# of Sympathy

- Sympathy is improperly applied when we speak of the mutual action of the Brain & every other part of ye System. - we had much better speak of Mutual Action arising from Sensation & Volition. One other Cause of Sympathy has been derived from the Anastomoses of Nerves independant of the Intervention of the Sensorium, but Dr Whyte has fully proved y^t there is no Foundation for such Sympathies

- It is evident still further when we attend to the distinct Nature of Our Sensations w^h would not be

Sympathy

the case if the nerves are accustomed.

2nd: It is evident from two tissues not being communicated laterally to any muscle on w: the impressions are made

3rd: In many cases where we think we see a communication of nerves, this communication disappears when the connection w: the sensorium is cut off.

4th: Communications of motion are apparent in many places without any communication of nerves.

5th: In those cases when the nerves do communicate we know the motion must be excited thro' the brain

Sympathy

by motions being taken off from them by stronger impressions made on the Brain. all these Argum: suf:ficiently prove that no Sympathies can depend upon the Anastomoses of Nerves independant of the Action of the Brain.

all Connections of motions are attended w:th Sensation - Propensity - or volition so that I am ready to doubt that mutual Actions do not depend on Anastomosis of nerves in the Brain, but are all of them originally more or less Arbitrary. - But don't we sometimes see Connections of motions where no

of Sympathy

Consciousness Sensation — or volition do attend? this we must grant but with this Restriction that they were originally attended with Sensation — & Propensity or volition — their becoming insensible is the Consequence of Habit.

But to all we have said I must add that there are Connections of motions w: do not depend upon the Intervention of the Brain. as the pain in the Teeth from the Noise of a File, w: depends upon Motion communicated directly thro the Bones from the Jaws to y: Ears.

# of Sympathy

- even soft parts do not be capable of propagating Oscillations as well as Bones. This is illustrated from the Case of Mr Boerhaave who is capable of distinguishing sounds by his Fingers. Inflamation is often propagated merely by the Communication of Blood Vessels. There is likewise a Continuity of membranes w: propagates motion, as in those pains w: are felt in the Glans Penis from a stone in the Bladder. This finishes our Lect. of the Nervous System.

Circulation of the Blood

This subject has attracted the attention of Physiologists for upwards of these 100 years. in treating of it I shall 1st speak of the several Cavities in w: the Blood is contained.

2 of the Course of the Blood.

3d: of the Powers w: move it &

4th: Some general Laws w: regard the Circulation.

1st The several Cavities are the Heart - Arteries - Veins &c.

1st Sort of the Heart. I suppose here you are all acquainted with

Circulation of the Blood.

its Anatomical Structure. I shall only Observe 1st it is a hollow Viscus consisting of 2 principal ventricles w:th 2 hollow Afundages called Auricules, & that it is fitt to the Arteries & Veins. These Auricles & ventricles consist of Muscular Fibres which run in various Directions. They are dilatable & contractable to such a Degree as entirely to destroy their Cavity, & press out every Drop of Blood from them. 2d let us now consider the Arteries. They are formed of different substances w:ch are applied to each Other in y: form

Circulation of the Blood

of Layers. they consist of 3 Coats, the external wch is of a cellular texture — the Muscular wch is of so compact a nature as to resemble a tendinous or ligamentous Coat. upon this Ld Hunter denies its being possessed of Irritability but some later Experiments prove this Opinion to be false. within the Muscular Coat is another smooth polished Coat for an Acct of wch see Anatomical Authors. — the Strength of the Arteries is very great wch appears from the

Circulation of the Blood

Resistance they are capable of overcoming. we have but few Experiments to show the relative force of the Arteries in different ages & Animals. Dr Livingsham found a force of 157 necessary to break the Aorta of a young man. he thinks the Absolute as well as relative force of the Arteries encreases as you recede from the Heart, but his Experiments do not ascertain that this force is exactly proportioned to the distance from the Heart. the

(a) I believe in general they are nearly the same altho' they admit of great variety.

of the Circulation of the Blood

Specific Gravity of the Arteries we know increases as we recede from the Heart. The thickness of the Arteries always diminishes in proportion to their Area, but then their Density increases & with this Density their Force likewise. The Form of the Arteries when distended with Fluids is always circular. they are in general Cylindrical & not Conical as was formerly supposed. This we prove from the Branches of Arteries being always larger than the Artery from whence they came, or exactly of the same size.

Circulation of the Blood

The course of the Arteries is seldom in a strait line, but almost always in a flexuous or winding form especially in those parts where they are sending off frequent Ramifications, all Branches go off from Arteries at acute Angles. we know of none that go off at Obtuse Angles. upon this whole much Pains has been laid upon this Subject than has been useful or proper.

The Terminations of the Arteries are of 3 kinds. 1st into veins by the Reflection of the Arteries 2nd into Cavities into which they pour red Blood from whence it is again absorbed by Veins as in the

Circulation of the Blood.

Corpora Cavernosa Penis &c. 3:
into Veins Arteries or Arteria pecun:
: de Genesis i.e: tubes wide not
convey Globules. These Veins
Arteries terminate in Porous Veins
or in Secretory tubes or in Open Air:
: ties as in the Abdomen &c into w: the
the fluid Matter found they
believe is exhaled in the form of
Vapour. The Arteries have been divided
beyond this, but I imagine w: the no kind
of Propriety.

The next Cavity it contains Blood
are the Veins. have they Muscular
Coats? – I think an obvious layer
of Muscles may be distinguished

near the Heart a considerable Distance below the various Ligatures. Hillchurn from Experiments on made on Irritability - I think we may infer a priori that most of the veins are destitute of Muscular Coats except the very small Branches. The Density of the veins is always greater than their corresponding Arteries, & this like the Density of the Arteries increases as you recede from the Heart. The veins according to some Anatomists are larger in their corresponding Arteries, & are more in Number, but w: distinguish

Circulation of the Blood

them most from Arteries is this
values. They all take their Rise
1 from red Arteries 2d from Lymp
Arteries & 3d from Absorbent Vessels
as in the Cortex Cerebri Pineale.
Where the Blood is effused from the
Arteries, & afterwards absorbed by
Veins without any immediate Com-
-munication. Lymph may
in some Cases be absorbed by the
Veins as in the Brain where no
Lymphatic Vessels have ever been
discovered. We find also in many
Cases as in Ecchymosis. Where

Circulation of the Blood

there is an Effusion of Blood, it is all absorbed in a very short time. hence the veins must be employed chiefly for this purpose. this finishes our Cur: of the Cavities in w: the Blood is contained.

II Let us now take notice of the course the Blood observes in the Circulation. - let us suppose it filling the right ventricle of the Heart. from this it is propelled into the Pulmonary Artery from wh: it is absorbed by the pulmonary veins & carried into the left Auricle & ventricle, from whence it

Circulation of the Blood

is propelled by the Contraction of the Heart into the Aorta which distributes it to every part of the Body from whence it is returned by veins into the Vena Cava & right Ventricle where we first found it.

We prove this to be the Course of the Blood 1st from Hemorrhages or wounds which deprive all parts of the Body alike of Blood, 2nd from the situation - Structure & Functions of the Valves of the Heart which admit of the Blood's passage only in One

Circulation of the Blood

way. 3d: from Ligatures which cause the veins to swell below them, & when very tight cause the Arteries to swell above them. 4th: from the structure of the valves of the veins which admit the Blood only in One way. 5th: from the Continuation of Arteries & veins being demonstrated by Injections & Microscopes. You all know that this Sys: of the Circulation applies only to Adults, the Blood circulates in a different manner in the Foetus as we shall say hereafter.

Circulation of the Blood

The motion of the two Ventricles of the Heart is synchronous as appears from a number of Experiments notwithstanding the contrary has been asserted by Dr Nicholls & others.

III - I shall now enquire into those powers by wch the Blood is moved. — The 1st of these is obviously the Heart wch some have supposed to be the only one. its power consists in its Muscular Contraction. But wt is it yt excites this Muscular Action? Why either a Vis Nervea or a Stimulus applied to the Heart itself! the Stimuli

Circulation of the Blood

a stimulus directly to the Heart and of two kinds 1 Distention or 2 acrid substances these are again divided into Mechanical & Chemical. No One has yet proved that Mechanical stimuli are applied to the Heart, nevertheless I think there is any thing like a Chemical stimulus applied to the Heart. For the Blood we know contains nothing acrid in it, & suppose it did the Heart by Length of time would loose its sensibility to it. I therefore imagine that Distention from the venous Blood only acts as a stimulus on the Heart.

Circulation of the Blood

There is likewise a considerable Influx of the vis Nervea into the Heart in common w: all Muscles, & upon this Influx the Stimulus of Distention depends. This is sufficiently proved from the Effects of Passions which we know are capable of encreasing the Action of the Heart. This you may remember gave Rise to our Conjecture of the Heart being a Voluntary Muscle. What is the Force w: ch w: the Heart contracts? – did the Circulation of the Blood depend alone on this, the Question would

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be of some consequence, but this we know is not the case. I would therefore reject all the solutions that have been given to this Proposition by the Physiologists & Mathematicians. we find them almost all differ in their Calculations. most of them have exalted it too high. in a word the Data on wch they found their Calculi are not to be admitted. Cinotrunes=tion occurs here & that is wth wch velo=city does the Blood move from the left ~~Auricle~~ Ventricle to the Aorta? this might be determined could we tally:

Circulation of the Blood

exact Area of the Aorta with the
size of the vessel. ~~weight gives~~
~~a balance to~~ But no Physiologists
have yet agreed in their Amounts of
this. in some Men it may be greater
than in Others. So that I think each
of these two Problems are equally
undetermined. On ye does the Alter=
=nate Contraction & Dilatation of the
Heart depend? – not on the Influx
of Arterious Blood, nor yet upon a
Influence of the Nerves of the Heart. the
Only Cause appears to be the Influx
of the Venous Blood w: is Alternately
applied & removed, there is a peu=
=liar

(a) The Arguments Pro. & Con. the prodigious Force of these Resistances may be seen in the Notes of last year upon the same Subject.

Circulation of the Blood

Structure of the Muscles of the Heart
w: disposes it to Alternate Contractions & Dilation. by the Heart

The Resistance to be overcome
1 Elasticity of the Arteries
2 The Pressure of the Atmosphere
3 Quantity of the Blood to be moved.
4 Enlargement of the Arteries as they proceed from the Heart.
5: Flexures & Angles of the Arteries.
6: The Effects of Anastomosis. & c
7: The Friction of the Blood upon the Arteries w: is supposed to be the most considerable Resistance. but the Resistance arising from the Actions of

Circulation of the Blood

Fluids on Solids is so inconsiderable as not to deserve mentioning.

8:ly The viscidity of the Blood. but this has been unjustly accused. all viscidity is obviated by the Heat of ye Body. — the component parts of the Blood are in a diffused state, upon this its permanent Fluidity depends. thus have I enumerated all the Resistances the Heart has to overcome. but they are by no means so great as has been supposed, nor can they be subjected to any regular Calculation. they do however retard & resist the Motion

(a) such as Dr. Nicholls - Dr. Hunter
& Dr. Hallen.

of the Heart a little, & that to such a Degree that I think we must call in some Other power to aid: for the Force & Velocity of the Blood besides the Action of the Heart this power then is the Action of the Arteries.

Physiologists have Objected to this because they have not been able to discover Muscular Fibres in the Arteries, but later Observations have shown them to us tho in a more compact & apparently Cartilaginous state in all the Arteries. I think in

(a) Mr. Bastheur now a Stud: in
this University. —

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by Reasoning a priori we might infer that the Arteries are possessed of Irritability, from the Difficulty of accounting for the Circulation of the Blood without supposing it. But this Muscular Fibre is proved beyond Doubt by some late Experiments by an ingenuous German Gentleman in an Inaugural Dissertation "De Arteriarum & venarum irritabilitate" — I formerly adduced many other Arguments drawn from Diseases of the Heart & Arteries, but these are of less Consequence, since the

Circulation of the Blood

Experiments before said have come to our hands. we have many confirmations of the Irritability of the Arteries from their Diseases such as Inflammations typical Fevers & Pulses & gangrenes, but these will come in better hereafter. It still remains a Question what additional Powers are employed in the Circulation of the Blood? - my Predecessor Dr. Whyte has wrote much on ye Oscillatory Motion of the smaller Arteries. for my part I have Difficulties

Circulation of the Blood.

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in understanding as well as admit-
-ting this Doctrine, but w: rather
chuse to attribute the motion of the
Blood in the small Arteries to the
Irritability we have been speaking
off. we have Reason to believe that this
Irritability increases as we recede from
the Heart. There may be other powers w:
assist in propelling the Blood thro y:
Capillary Arteries Analogous to those
powers w: promote the Circulation of
Sap in Plants. how far the Action
of Our Nerves may act I will not

(a) We find repeated shocks of Electricity promotes & quickens the Growth of Plants.

Circulation of the Blood

practised to determine.[a] I see upon the whole no necessity for calling in the Oscillatory power of Dr Wright. Heat can have no Effect in accelerating the Circulation in the small vessels, for we have no Proofs of its either generating or encreasing in the Capillary Arteries. Some have called in Intestine Motion, but this never can exist in the Circumstances wch attend the Blood's Motion in these small vessels.

Let us now enquire into the powers wch propell the Blood in the Veins. These are call'd the powers

Circulation of the Blood

we have been speaking off. But these ~~Only~~ Alone are not sufficient. 2:d Dr Walshman has proved that Irritability is not peculiar to the venous sinus only but, to several beins which examined as the Vena Cava descendens - Jugulars & an or two more. But he could not find it in the Arteries & smaller beins. nor do I think the smace beins are possessed of the least Irritability. 3:d Another power is the action of incumbent muscles - this acts considerably in propelling the Blood in the small vessels or rather chiefly, for I cannot

Circulation of the Blood

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unrivalled of any other auxiliary power

4th. The alternate action of the Diaphragm in Respiration contributes to propel the Blood thro' the Liver where it is most apt to stagnate. we shall therefore proceed to speak of Respiration & its action in propelling the Blood thro' the Lungs.

# of Respiration.

I suppose you are all acquainted w: the properties of the Air — such as its Elasticity — Density — Gravity &c — I likewise take it for granted that you are equally well acquainted w: the anatomical structure of the Lungs &c

I shall therefore proceed to explain Respiration. we shall enquire into the following Circumstances.

1 by w: Organs Respiration is performd

2 w: is the Effect of these Alternate Actions of the Thorax on the Blood.?

3 Why these Motions are Alternate?

Respiration

1st W: Changes the Air taken in undergoes?

2d: By W: Power is Respiration carried on? — We must to understand this consider the Lungs in the light of a Bladder W: may be alternately filled & emptied of Air at pleasure. The Lungs are enlarged by the Thorax in Inspiration during W: time the Air rushes into them. The Thorax is enlarged in all Directions in Mechanically by the Action of the Diaphragm and the Intercostal Muscles by the first vertically, & by the last Horizontally.

Respiration

2nd 2: W: are the Effects of Inspiration: nate Dilatations & Contractions of the Lungs on the motion of the Blood: 2. — To quicken its passage thro the Lungs.

3: Why are they Alternate? from an uneasy Sensation which the Lungs feel after Inspiration & Expiration. — Inspiration is a violent State from the Exertion of Muscular parts, & upon this Cu: Expiration very naturally follows it. There is Another Use or Necessity for Respiration ~~big~~ which leads us to enquire in to —

Respiration

1st the Changes w: the Air undergoes in Breathing? This was supposed formerly to lose its Elasticity by being taken into the Lungs, but some late Experiments show us y: the Elas=ticity of the Air is rather increased than diminished. There are many other Opinions of the Changes of y Air in the Lungs w: do not deserve our Notice. The present established Opi=nion is that there are Vapours exhaled from the Lungs analogous to those w: rise from many Plants in y Bath & from Liquors in Fermentation.

Of Respiration

these vapours are called Mephitic Air.

It is universally a Poison to Animal Life. There is no other way of rendering it inert but diffusing it with common Atmospheric Air. Respiration then seems to be provided as an Antidote to this vapour, common Air seems to dissolve this Air, & is capable of being saturated w: it in such a manner as to leave the Lungs only for a certain time in a limited Quantity.

Effects of the Circulation

We come now to speak of the Effects of the Circulation of the Blood. there are 1: to distribute Heat to all parts of the body.

2nd to Distribute Humidity to the body.

3rd to give Tension to the System. it is well known y: it strengthens y: Arteries, & may add every Muscular Fibre too.

4th: to afford secreted liquors, and among Others the Nutritious Juice. this leads us to speak of what we proposed formerly as the Vessel part of our System, or to the Doctrine of

Digestion

Animal Fluids. some begin w: the
Blood as Dr: Haller, others begin with
the Matters out of w: the Fluids are form=
=ed. the Latter of these Methods appears
to me to be the best, & I shall therefore
adopt it. in considering these subjects
many Questions occur such as the induction
Deglutition &c which have no imediate
Connection w: the nature of Animal Fluids
so y: I shall take no notice of them, but
proceed imediately to consider the nature
of Animal Nourishment of which the Ani=
=mal solids consist. All nutritious mat=
=ters consist originally ~~upon~~ of vegitables
- even those Animals on w: ch we live,
are substented by vegitables, or by

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I am friend
your humble

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Lyre